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Otolith atlas for the western Mediterranean, north and central eastern Atlantic

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SUMMARY: The sagittal otolith of 348 species, belonging to 99 families and 22 orders of marine Teleostean fishes from the north and central eastern Atlantic and western Mediterranean were described using morphological and morphometric characters. The morphological descriptions were based on the otolith shape, outline and sulcus acusticus features. The morphometric parameters determined were otolith length (OL, mm), height (OH, mm), perimeter (P; mm) and area (A; mm^2) and were expressed in terms of shape indices as circularity (P^2/A), rectangularity ($A/(OL \times OH)$), aspect ratio (OH/OL; %) and OL/fish size. The present Atlas provides information that complements the characterization of some ichthyologic taxa. In addition, it constitutes an important instrument for species identification using sagittal otoliths collected in fossiliferous layers, in archaeological sites or in feeding remains of bony fish predators.

Keywords: otolith, sagitta, morphology, morphometry, western Mediterranean, north eastern Atlantic, central eastern Atlantic.

RESUMEN: Otolitos de peces del mediterráneo occidental y del atlántico central y nororiental. – Se han descrito morfológica y morfométricamente los otolitos sagitta de 348 especies, pertenecientes a 99 familias y 22 ordenes, procedentes de Atlántico Oriental Central y Norte y el Mediterráneo occidental. La descripción morfológica se ha basado en las caraterísticas de la forma del otolito, de su contorno y del surco acústico. Se han dterminado los parámetros biométricos siguientes: longitud del otolito (OL, mm), anchura (OH, mm), perímetro (P; mm) y área (A; mm^2) y se han expresado con distintos índices de forma: circularidad (P^2/A), rectangularidad ($A/(OL \times OH)$), aspecto (OH/OL; %) y OL/longitud del pez. Este atlas da nueva información para complementar la caracterización de algunos taxones ictiológicos. Además, constituye un instrumento importante para identificar especies mediante otolitos sagitta en yacimientos fósiles y arqueológicos o en estudios de alimentación de especies ictiófagas.

Palabras clave: otolito, sagitta, morfología, morfometría, Mediterráneo Occidental, Atlántico Nororiental, Atlántico centro-oriental.

INTRODUCTION

Otoliths are acellular concretions of calcium carbonate and other inorganic salts, which develop over a protein matrix (Carlström, 1963; Blacker, 1969; Degens *et al*., 1969; Cermeño *et al*., 2006) in the inner ear of vertebrates, in close association with the sensitive maculae of the labyrinthic compartments (Cordier and Dalcq, 1954; Weichert and Prech, 1981; Hildebrand, 1988; Jobling, 1995). Otoliths are constituted by three pairs of calcareous structures, the *sagittae*, *lapilli* and *asterisci*, which are found in the inner ear (Fig. 1). They are associated with the saccule, utricle and lagena end organs respectively

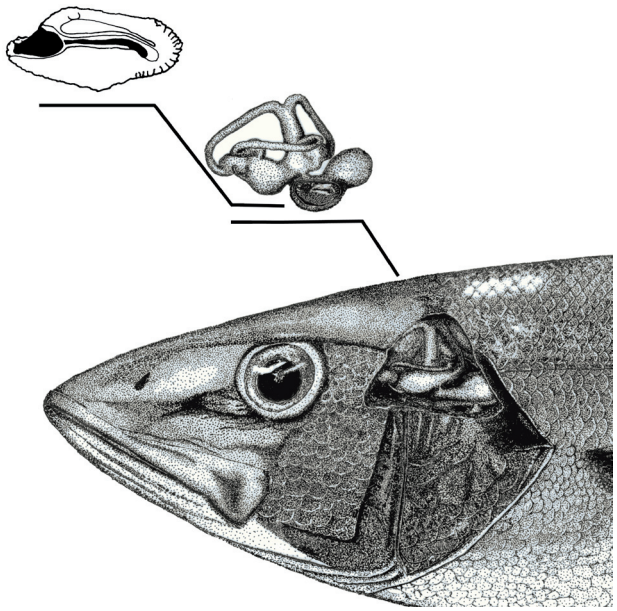

FIG. 1. – Localization the sagittal otolith in bony fish. Drawing by Nuno Miranda, adapted from Assis (2004), with permission from the Câmara Municipal de Cascais of Portugal.

(Platt and Popper, 1981), which in turn are associated with vestibular (balance) and acoustic (sound detection) functions (Popper and Fay, 1993). The sagitta, which is formed by aragonite crystals (e.g., Degens *et al*., 1969), is the otolith with the largest morphological variability and therefore is the most studied.

Otoliths are three times more dense than the rest of the fish's body (Popper and Coombs, 1982), and have essentially static and otic functions (Grassé, 1958; Romer, 1966; Lowenstein, 1971; Harder, 1975; Lagler *et al*., 1977; Popper and Platt, 1993; Moyle and Cech, 1996; Ramcharitar *et al*., 2004). Due to some of their characteristics (size, morphologic specificity, accessibility, chemical composition, microstructure, ontogenic stage in which they are formed and mode of growth) and the dependency of these properties on the variation in environmental factors (e.g., Morales-Nin, 1987), otoliths are one of the fish's more useful anatomic structures for various studies, which lead to a large number of practical applications (e.g. Panella 1971; Morales-Nin and Panfili, 2002).

Such applications are not limited to ichthyology, but are widely extended to the study of the feeding ecology of fish predators, and to some aspects of palaeontology, stratigraphy, archaeology and zoogeography.

Historical background

Aristotle (4th century BC) was the first author to mention the existence of a pair of "stones" in the skull of some fish species (Campbell, 1929; Chaine and Duvergier, 1934; Adams, 1940; Sanz Echeverría, 1943; Stinton, 1975). During the classical period, the middle ages, and the larger part of the renaissance, the occurrence of otoliths was referenced in a growing number of species (Koken, 1884; Chaine and Duvergier, 1934).

While for naturalists, otoliths were just one more anatomical part that deserved, at most, to be referred to as existing, in folklore, especially during the second half of the 16th century and the first half of the 17th century, they were associated with several superstitious beliefs, and attributed healing properties and/or divine powers (Koken, 1884; Campbell, 1929; Chaine and Duvergier, 1934; Adams, 1940; Sanz-Echeverria, 1943; Jonet, 1972-73). These fantasies, some of which had been recovered from classical philosophers, found their way into the writings of some eminent naturalists, such as Guillaume Rondelet, Pierre Belon and Ulysse Aldrovandi, who supported these beliefs (Koken, 1884; Chaine and Duvergier, 1934; Sanz Echeverria, 1943) and therefore endowed them with an unquestionable credibility.

Duffin (2007) gives an extensive account of the popular use of otoliths since classic times to the present. These uses included divining maritime weather conditions and protecting sailors against sea storms; aphrodisiac properties; relief of several types of pain, colic and swelling; elimination of calculi from several organs; and a cure for diseases such as malaria, jaundice, recurrent fevers, and nose bleeds.

The North American Indians were also well aware of the voluminous sagittal otoliths of the Sciaenidae and believed that they had magical powers (Stinton, 1975).

In the first half of the 19th century, Georges Cuvier was the first naturalist to describe the "ear stones" precisely, the first to recognize their morphological specificity (Koken, 1884; Chaine and Duvergier, 1934; Sanz Echeverria, 1943; Hecht, 1978; Nolf, 1985) and the first to state that otoliths could be used to identify fish species (Campbell, 1929; Chaine and Duvergier, 1934). It was also Cuvier who determined the most important features of otoliths, and insisted that the "longitudinal furrow on the inner face" should be considered as the most

relevant of them all (Campbell, 1929; Chaine and Duvergier, 1934).

The first illustration of a fossil otolith was produced in 1833 by Lea (Stinton, 1975), even though it was not identified as such. Shortly after that time, some fossils were identified as fish otoliths (Koken, 1884) and afterwards, many authors reported the occurrence of fossil otoliths in Tertiary layers from an increasing number of different locations, where no other fish remains were preserved (Higgins, 1868).

By the end of the 19th century the morphology of the inner ear was already well known (Hawkins, 1993). However, the same was not true for the "ear stones", as the authors that followed Cuvier had limited their studies to explaining the morphological significance of otoliths and describing their location in the inner ear (Chaine and Duvergier, 1934).

In the last decade of the 19th century, a collection of Mediterranean recent fish otoliths was offered to E. Koken so that he could use it to interpret the fossil otoliths in his collection. In a relatively short period of time, Koken published a series of six monographs (Koken, 1884, 1885 in Posthumus, 1924, 1888, 1889 in Posthumus, 1924, 1891a, b), which was a fundamental turning point in the history of the study of fish otoliths. In his first work, dated 1884, Koken began with a short historical account of the knowledge of otoliths, pointed out their location in the fish inner ear, described their basic morphology, proposed a terminology for their main parts and defended the importance of studying them in recent fish in order to study fossil otoliths, for which he proposed a unique nomenclature. Still in that publication, Koken (1884) described in detail and pictured the otoliths of 32 recent species, belonging to 26 genera, as well as otoliths from a considerable number of fossil species.

After Koken's death, still in the 19th century, his work stimulated a considerable increase in the number of works on otoliths, by then already supported by other studies carried out on recent species.

In the beginning of the 20th century, despite the progressive increase in the number of published works on Tertiary fossil otoliths, there was only a slight increase in research on recent fish otoliths, which, although significant, was not enough to assure a solid basal knowledge for paleontologists to increase the precision of their identifications.

After the first two decades of the 20th century, the number of otoliths of recent species described and pictured was not yet very high and the documents published were generally not very precise, therefore large gaps remained to be filled (Chaine and Duvergier, 1934). In fact, few authors referred to the enormous morphological variability that characterizes otoliths and the number of specimens used to form the description was seldom referred to. It was thus very difficult to correctly integrate the fossil otoliths discovered with the recent fish classifications, as the knowledge on otolith morphology was still very limited.

Between the 1920s and 1960s, some scientists carried out thorough, extensive and more or less detailed studies on the subject. Of special interest are the series of works produced by Frost (1925a, b, c; 1926a, b, c, 1927a, b, 1928a, b, 1929a, b, 1930a, b), Sanz-Echeverría (1926, 1928, 1929a, b, 1930, 1931, 1932, 1935, 1936, 1937, 1941, 1943, 1949, 1950), Chaine and Duvergier (1922, 1923, 1927, 1928a, 1932, 1934), Chaine (1935, 1936, 1937, 1938, 1941-42, 1956, 1957, 1958), Weiler (1942, 1963), and Bauzá-Rullán (1954, 1956, 1957, 1958, 1960a, b, 1961, 1962, 1968), among others.

While the study of fossil otoliths has continued at a good pace by numerous researchers until the present (Hecht, 1978), the period of enthusiasm for studying recent fish otoliths by Ichthyologists was very ephemeral (Post and Hecht, 1977). In the 1950s it decreased to its minimal expression, while in the 1960s it was almost insignificant. By then, only a few isolated and sporadic papers were published. This is evident in the reference collections of Weiler (1968a), Huyghebaert and Nolf (1979), Gaemers (1980, 1982, 1995) and Nolf (1985). The knowledge on recent otoliths was, however, far from being complete.

At the end of the 1960s and the beginning of the 1970s, new perspectives were opened for using otoliths in age determination and studying the feeding relationships between fish predators and their prey. These tendencies have turned otoliths into one of the most useful anatomic parts of fish.

As a result, works that picture and describe the otoliths of recent fish species have reappeared in the literature, depending on specific needs or the availability of the authors' material (e.g. Hureau, 1962; Eziuzo, 1963; Fitch and Craig, 1964; Nijssen, 1964; Bolineau-Coatanea, 1968; Weiler, 1968b; Fitch and Barker, 1972; Casteel, 1974; Cyrus and Blaber, 1982; Radtke *et al*., 1982; Berdar and Li Greci, 1986; Sideleva and Zubina, 1990).

Since the end of the 1970s, some short notes on otoliths have been published (e.g. Moreno *et al*., 1979; Li Greci, 1981) along with some more or less extensive otolith studies, with and without identification keys, at the generic level (e.g. Wirtz, 1976; Nolf, 1979*a*), at the family level (e.g. Berinkey, 1956; Rousset, 1978, 1983; Akkiran, 1985; Abilhoa and Corrêa, 1992/93; Corrêa and Viana, 1992/93; Lemos *et al*., 1992/93; 1995a, b; Hofstaeter *et al*., 1996; Schwarzhans, 1993), and at a more generalized level (e.g. Berinkey, 1957; Tilak, 1963; Morrow, 1977, 1979; Schwarzhans, 1980, 1999; Mollo, 1981; Breiby, 1985; Nolf, 1985; Martinez and Monasterio de Gonzo, 1991; Brzobohaty and Nolf, 1996; Reichenbacher, 2004; Girone *et al*., 2006), some of them with very detailed drawings or photographs. In addition, otolith digital catalogues have been created, such as Baremore and Bethea, (2005), dedicated to the Gulf of Mexico, and more recently, the AFORO database, which is an interactive worldwide catalogue that includes an automatic system for identifying species based on mathematical descriptions of otolith outlines (Lombarte *et al*., 2006).

In geographic terms, among the large otolith catalogues of recent species, due to their coverage and detail, those of Schmidt (1968), including the east Atlantic fish fauna; Morrow (1977, 1979), dedicated to the North American Pacific coast; Nolf (1985), of global scope, including fossil otoliths; Härkönen (1986), on North Sea fishes; Hecht (1987) and Smale *et al*. (1995), dealing with South African fish species, Williams and McEldowney (1990), concerned with the Australian Antarctic region; Rivaton and Bourret (1999), dedicated to the Indo Pacific region; García-Godos and Naveda (2001) on Peruvian waters; Volpedo and Echeverría (2000) on Argentinian fishes; Assis (2000, 2004), on Portuguese coastal, estuarine and freshwater species; Campana (2004) dedicated to North American species, and Furlani *et al*. (2007) devoted to Australian temperate waters, deserve special reference.

In addition to these works that are specifically dedicated to otoliths, some authors, in recognition of the importance of otolith morphology, include more or less detailed images and/or descriptions of otoliths in publications dedicated to completely different subject matters, such as the anatomy of fish species (e.g. Philips, 1942; Daget, 1962; Pietsch, 1972; Collette and Chao, 1975; Bortone, 1977; Casadevall *et al*., 1996; Assis, 2003, 2005); monographic synopses on fish taxa (e.g. Cavallaro *et al*., 1978; Quignard and Douchement, 1991a, b); description of new recent species (e.g. Carter, 1983; Paulin, 1985; Matallanas, 1986; Nielsen, 1986; Hensley and Smale, 1997); taxonomic revision of fish taxa (e.g. Nafpaktitis and Paxton, 1968; Pietsch, 1972; Collette and Chao, 1975; Menni and Miguelarena, 1979; Martin and Heemstra, 1988; Assis, 1993; Agafonova, 1994; Grifiths and Heemstra, 1995; Nielsen, 1995); phylogenetic relationships (e.g. Gaemers, 1984; Nolf 1979 b, c; Nolf and Steurbaut 1989 a, Monteiro *et al*. 2005, Reichenbacher *et al*. 2007); check lists (e.g. Kotthaus, 1974; Porteiro *et al*., 1996); records of species occurrence (e.g. Fitch and Craig, 1964; Rodriguez-Roda, 1980; Matallanas, 1983; Berdar and Li Greci, 1986); species, population or fishery stock identification (e.g. Yefanov and Khorevin, 1979; Messieh, *et al*., 1989; Lombarte and Castellón, 1991; Castonguay *et al*., 1991; Campana and Casselman, 1993; Friedland and Reddin, 1994; Torres *et al*., 2000; Tuset *et al*. 2003a, 2006.); ecomorphology and functional hearing in fishes (e.g. Gauldie, 1988; Lombarte, 1992; Popper and Platt, 1993; Aguirre and Lombarte, 1999; Lychakov and Rebane, 2000; Ramcharitar *et al*., 2001, 2004; Aguirre, 2003; Tuset *et al*., 2003b; Volpedo and Echevarria 2003; Cruz and Lombarte, 2004; Lychakov *et al*., 2006; Lombarte and Cruz, 2007); the relationship between fish growth and ageing (Bird *et al*., 1986; Lombarte and Morales-Nin, 1995; Morales-Nin and Panfili, 2002; Cardinale *et al*., 2004); and analogies between growth in recent otoliths and fossil otoliths (Woydack and Morales-Nin, 2001).

The present guide provides a volume of information to complement the characterization of some ichthyologic taxa, which is potentially useful in systematic and/or phylogenetic studies of bony fishes. In addition, it constitutes an important instrument for species identification using sagittal otoliths collected in fossiliferous layers, in archaeological sites or in feeding remains of bony fish predators.

MATERIAL AND METHODS

Material and graphical representation of otoliths

Otoliths were collected from 348 species, belonging to 99 families and 22 orders of Teleostean fishes from the north and central eastern Atlantic (NEA and CEA respectively), and the western Mediterranean

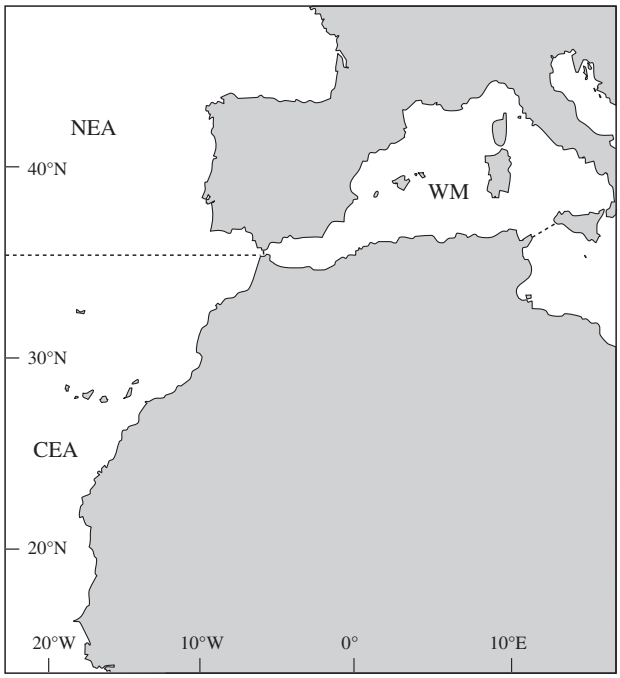

FIG. 2. – Map showing the areas where the otoliths were collected: North Eastern Atlantic (NEA), Central Eastern Atlantic (CEA) and Western Mediterranean (WM).

(WM) (Fig. 2). The species come from six different environments (Froese and Pauly, 2007): reef-associated (12.6%), pelagic (11.5%), bathypelagic (8.6%), benthopelagic (13.5%), bathydemersal (11.5%) and demersal (42.3%). Moreover, 77.0% of the species are strictly marine, 18.4% inhabit brackish and marine waters and 4.6% occur in freshwater, brackish and marine environments.

The classification system used was based on Nelson (2006) and the species were named following the criteria of the online fish catalogue of the California Academy of Science (Eschmeyer *et al*., 1998). The left otolith of each pair was used in the measurements and figures. In order to describe the intraspecific variability, whenever possible three otoliths were selected to represent the maximum size and distribution range. Pictures of the otoliths were taken with a digital camera under a binocular microscope, with the most convenient magnification in each case. The image was taken of the internal side (medial or proximal) of the otolith as this side presents the sulcus acusticus (a groove along the surface of the sagitta). To obtain a good representation of the sagitta contour, the image must be well contrasted with a homogeneous black background. The otoliths were always represented with the respective dorsal margin to the top of the image and anterior (rostral) region to the right.

The otoliths referenced as NEA (north eastern Atlantic) belong to the collection of Carlos A. Assis, at the Faculty of Science of the University of Lisbon, Portugal; the ones referenced as CEA (central eastern Atlantic) belong to the collection of Victor M. Tuset, at the Instituto Canario de Ciencias Marinas, Canary Islands, Spain; and those referenced as WM (western Mediterranean) belong to the collection of Antoni Lonbarte, at the Institut de Ciències del Mar-CSIC; Barcelona, Catalonia, Spain.

Morphometry

The shape parameters, length (OL, mm), height (OH, mm), perimeter (P, mm) and area (A, mm^2), were measured in all the otoliths using image processing systems. Moreover, otolith shape indices were calculated: circularity (P^2/A), rectangularity ($A/(OL \times OH)$), aspect ratio (OH/OL; %) and OL/fish size. Total length (TL, mm) was the reference for fish size, but standard length (SL, mm) or cephalic length (CL, mm) was used when total length was not available. Due to caudal damage in some groups, such as macrourids and some pelagic fishes, the preanal (PL, mm) or the furcal length (FL, mm) was measured.

Anatomical terminology

To promote uniformity of criteria the terms used in this guide compile and review the definitions applied by previous authors in similar works (Chaine and Duvergier, 1923, 1934; Adams, 1940; Eziuzo, 1963; Hecht and Hecht, 1978; Schwarzhans, 1972, 1978; Nolf, 1985; Härkönen, 1986; Smale *et al*., 1995; Rivaton and Bourret, 1999; Assis, 2000, 2004; Campana, 2004; Furlani *et al*., 2007). The descriptions provided focus only on the main characters so they can be used more easily in species identification (Fig. 3). Some comments may be added to the descriptions to point out the main differences between close species. For each section, the terms used to describe the otolith parts and their morphological variations are given bellow. The images provided in Figures 4 to 9 help to illustrate the definitions.

Otolith shape (synonym: otolith outline)

Otoliths have very diverse outline types with considerable intra and inter-species variation. This character is very subjective as there is no standard

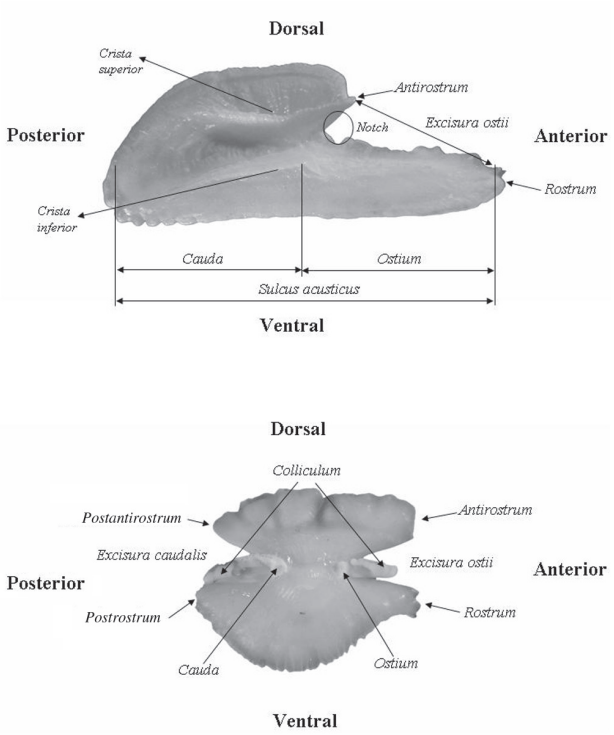

FIG. 3. – View of the mesial surface of the sagitta illustrating the most relevant features.

classification of shape and the assignation depends on the researcher. Figure 4 displays typical examples of the 24 different otolith shapes considered for the purposes of the present work. However, because an otolith's shape does not always fit one of the defined typical shapes exactly, or whenever there is variation within the sample of a particular species, the word "to" between the names of two shapes indicates that the otolith in question has a shape that is between the two forms indicated (e.g. *elliptic to oval* describes a shape that is intermediate between the two typical shapes). This notation will be used whenever necessary for describing other otolith characters.

The typical otolith sagitta is a laterally compressed structure, most frequently longer than wide and wider than thick, with a narrow longitudinal depression along its medial face, the sulcus acusticus, or simply sulcus. The sulcus is commonly divided into two sections, the ostium and the cauda, which are limited by a more or less developed and evident rim, the crista, and have a frequently raised floor, the collicullum. The ostium is anterior and generally reaches the anterior margin of the otolith where it opens in an excisura ostii. The cauda is posterior and most frequently closed, often with a ventrally curved tip that does not reach the posterior margin of the otolith. In such cases, the posterior region of the otolith has no defined defined features. However, in the otoliths of some species, the cauda reaches the posterior margin of the otolith and opens in an excisura caudalis. In these cases, a pseudorostrum and a pseudoantirostrum may be differentiated (Fig. 3).

Sulcus acusticus (synonymy: groove, inner groove, medial groove, sulcus acousticus, sulcus)

The sulcus acusticus is an important part of the sagitta, as some of its characteristics are among the most important features for species identification. The type of opening displayed by the sulcus, the morphological relationship between the ostium and the cauda, and the position of the sulcus are particularly important.

The sulcus opening may be classified as follows (Fig. 5):

Ostial. Sulcus with an ostium open widely in the anterior margin of the otolith, and with a cauda distinctly closed far away from the posterior margin.

Caudal. Sulcus with a cauda open widely in the margin of the otolith, while the ostium is closed or has an indistinct opening.

Pseudo-ostiocaudal (synonymy: pseudobiostial, ostio-pseudocaudal). Sulcus with both ends very close to the opposing margins of the otolith; the openings may be indistinct or reduced to very small, narrow channels.

Mesial. Sulcus normally much reduced, closed at both ends and usually very far from the otolith margins.

Pseudo-ostial. Sulcus with a closed ostium close to the anterior margin of the otolith, while the cauda is closed and distinctly far away from the posterior margin.

Para-ostial. Sulcus that opens in the margin of the otolith through a reduced, narrow channel, while the cauda is normally closed and distinctly far away from the otolith margin.

Ostio-caudal (synonymy: biostial). Sulcus with both the ostium and the cauda widely open in the opposing margins of the otolith.

The sulcus separates a dorsal and a ventral area in the medial face of the otolith and, depending on their relative proportions, the position of the sulcus may be classified as follows (Fig. 5):

Inframedian. Sulcus generally positioned below the longitudinal midline of the otolith; the ventral area is noticeably smaller than the dorsal area.

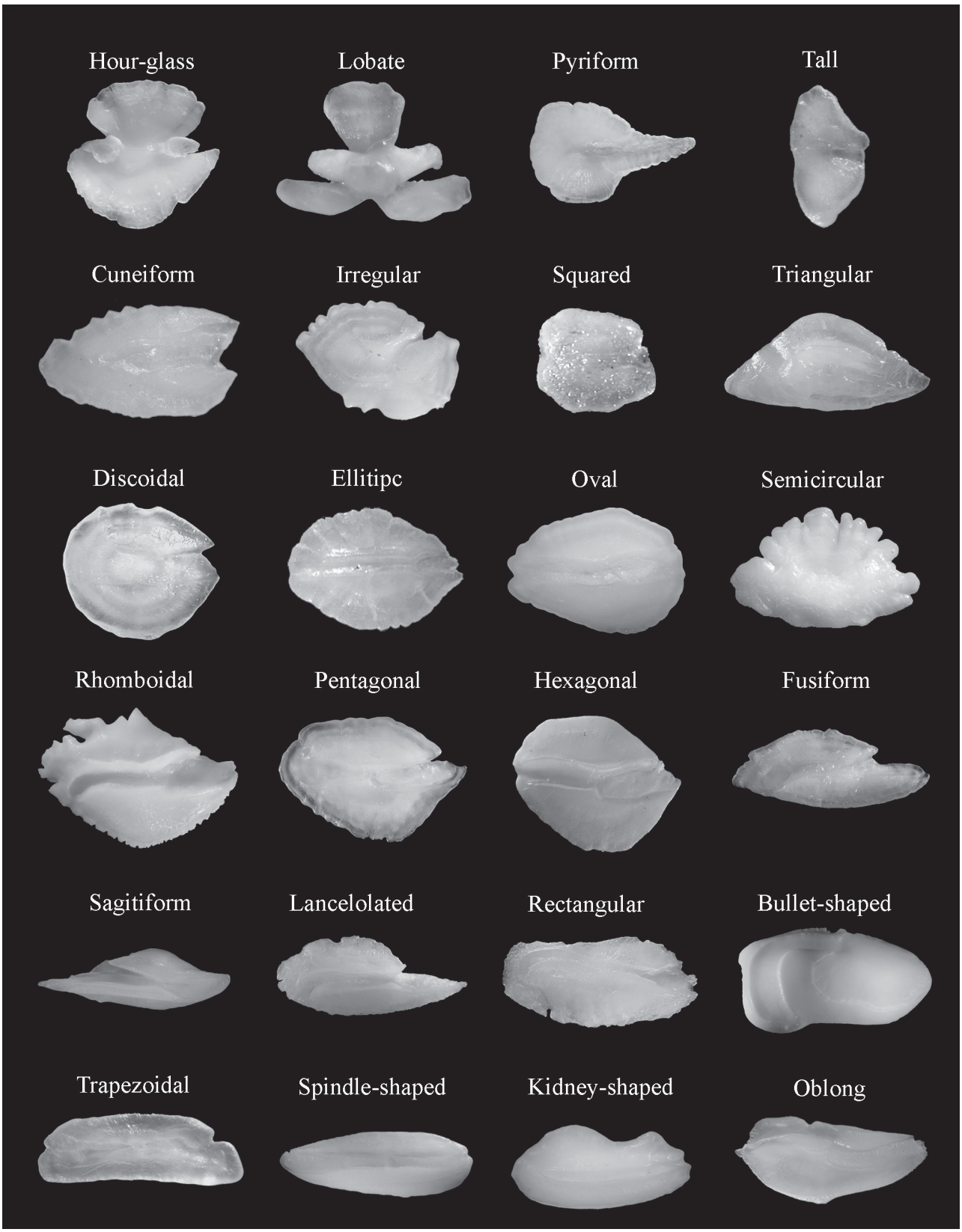

FIG. 4. – Terms used to describe the shapes of the otolith's outline.

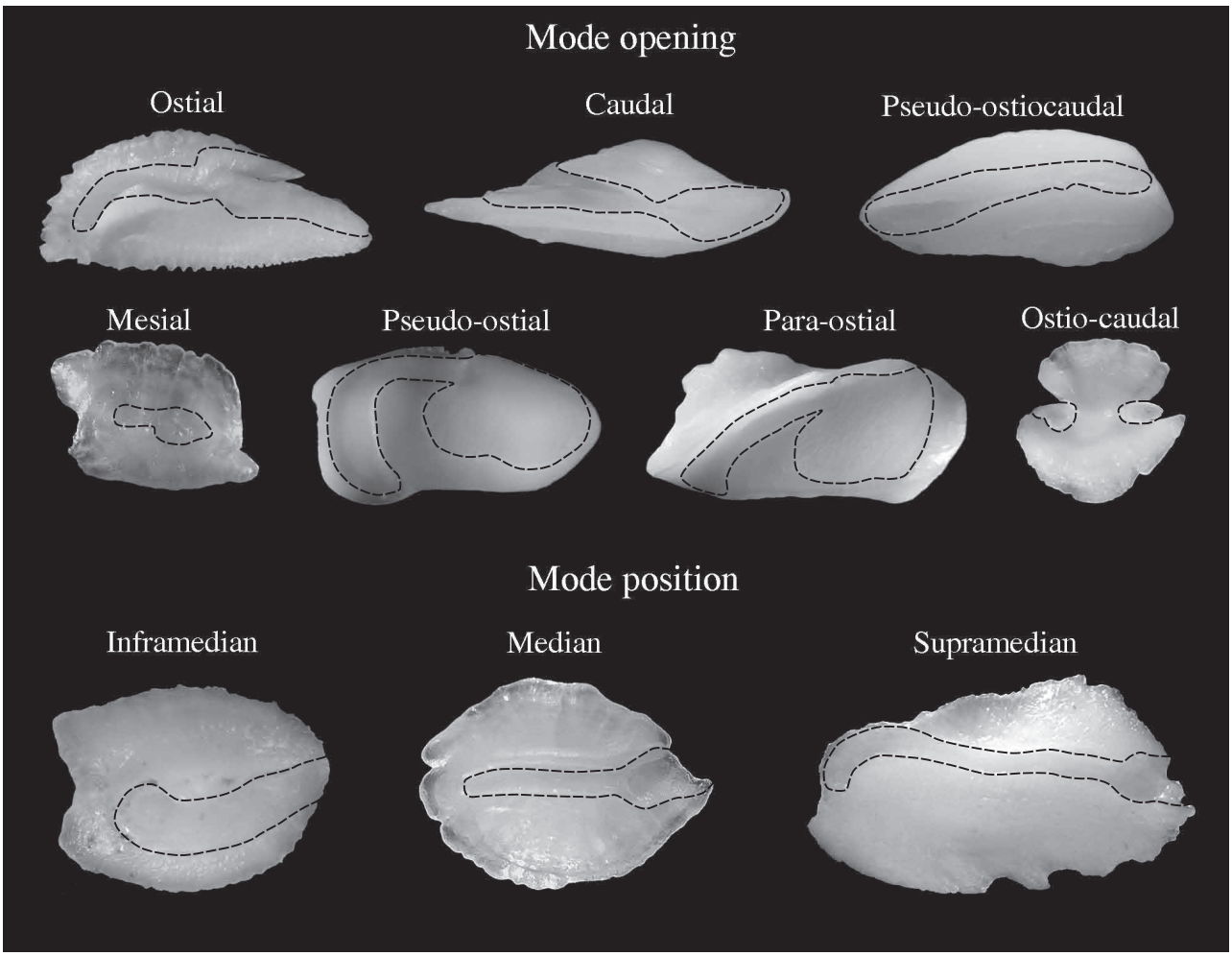

FIG. 5. – Terms used to describe different types of sulcus acusticus (sulcus limited by a discontinous line).

Median. Sulcus generally positioned on the longitudinal midline of the otolith; the ventral and dorsal areas are similar in size.

Supramedian. Sulcus generally positioned above the longitudinal midline of the otolith; the ventral area is noticeably larger than the dorsal area.

Several types of sulcus may be defined in terms of the relationship between the ostium and the cauda as follows:

Archaesulcoid. Sulcus simple and undifferentiated, without a clear division between the ostium and the cauda. The transition between the two components is almost indistinguishable.

Pseudo-archaesulcoid. Sulcus with a poorly defined transition between the ostium and the cauda, but marked by a slight slope or by a different transversal section.

Homosulcoid. Sulcus with ostium and cauda clearly differentiated, but similar in shape and almost symmetrical.

Heterosulcoid. Sulcus with ostium and cauda clearly differentiated, but very different in shape.

Ostium

The ostium is the most diverse component of the sulcus in terms of shape. Its diversity is not only related to the area of the anterior region that is sunken to form the sulcus, but also to the region where the cauda connects to the ostium, which dictates the curvature of the sulcal walls in the region of confluence. For the purposes of the present guide, the following types of ostium can be defined (Fig. 6):

Bent-concave. The cauda connects to one of the sides of the ostium (normally the dorsal side) rather than the middle. The ostium wall is straight or forms a regular curve along the sulcus, while the ventral forms a conspicuous but markedly concave bend.

Bent. The cauda connects to one of the sides of the ostium (normally the dorsal side) rather than the

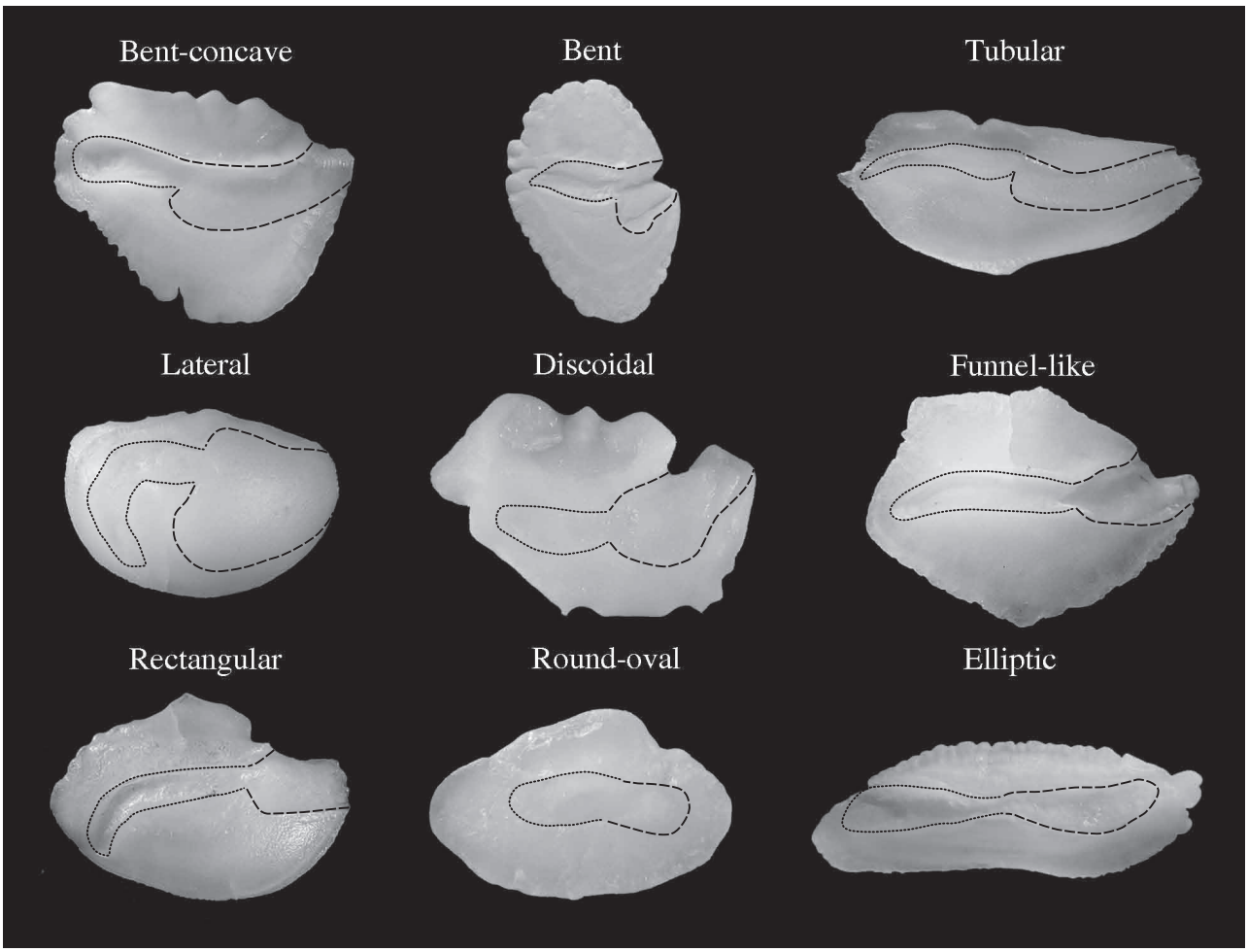

FIG. 6. – Terms used to define the ostial region of the sulcus acusticus (ostium limited by a discontinuous line; cauda limited by a dashed line).

middle. The ostium wall is straight or forms a regular curve along the sulcus, while the ventral forms a conspicuous but straight bend.

Tubular. The ostium is rather long and its walls are straight or curved, but they follow a fairly parallel path from the region of confluence with the cauda to the anterior tip.

Lateral. Both walls of the ostium have marked bends immediately next to the connection with the cauda; the ostium has its largest width in that region and narrows anteriorly.

Discoidal. The dorsal and ventral cristae limit a discoid shaped ostium.

Funnel-like. The walls of the ostium are straight or concave, but more or less symmetrical, and spread apart anterior wise from the region of confluence with the cauda.

Rectangular. The ostium is very close to tubular, but much shorter.

Round-oval. The ostium is close to circular.

Elliptic. The ostium is long and elliptic.

Cauda

The shape of the cauda may be divided into three types: tubular, elliptic or round-oval (see description above in the ostium section with the convenient adaptations) (Fig. 7). If the cauda is tubular, however, several subdivisions may be considered depending on the magnitude of the posterior curvature: straight, slightly curved, strongly curved, markedly curved, curled (around <30º, 30-60º, 60-100º, 100º> respectively) or sinuous. The curvature may begin from the anterior, the middle or the posterior regions of the cauda (Fig. 7).

Anterior and posterior otolith regions

Three structures may be differentiated in the anterior region: the rostrum, the antirostrum and the

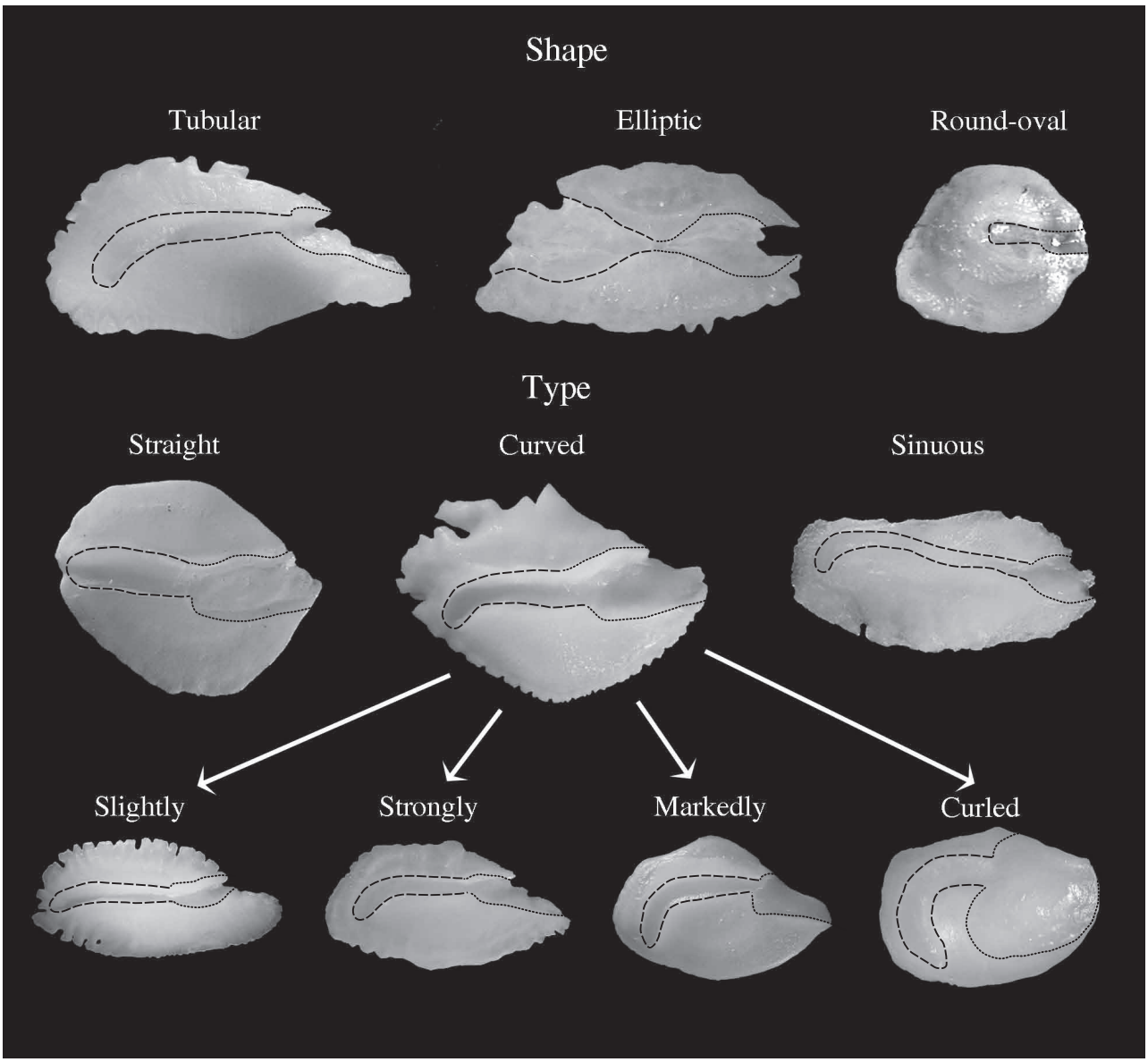

FIG. 7. – Different types of cauda, depending on shape and curvature (cauda limited by a discontinuous line; ostium limited by a dashed line).

excisura ostii. The rostrum is normally a protuberance in the anterior margin of the otolith below the opening of the ostium and frequently includes the anterior most point of the otolith. The antirostrum is a protuberance that is normally smaller than the rostrum that sometimes develops above the opening of the ostium when the excisura forms a notch. The shape of both the rostrum and the antirostrum may be described as peaked, round or blunt. The diagrams of the rostrum and antirostrum by Smale *et al*. (1995) clearly show the relation between the type of sulcus and the presence or absence of these structures.

The excisura ostii (synonymy: cisura, excisure, excisur, excisura major, fissure, excisura) is the portion of the anterior margin of the otolith where the ostium opens. Normally, the excisura is located between the rostrum and the antirostrum, when both are differentiated. It may be notched (acute or round, shallow or deep), even if it comprises an indentation in the otolith margin or not.

In the posterior region of some otoliths (of those with an ostiocaudal sulcus) a similar set of these structures may be developed, namely, the postrostrum (synonymy: pseudorostrum, pseudo-rostro), the postantirostrum (synonymy: pseudoantirostrum, pararostrum, pseudo-anti-rostro) and the excisura caudalis (synonymy: kaudale exzisur, excisura minor, pseudo-excisura ostii, pseudo-excisura). The

terms used to describe the shape of these structures are similar to those already presented for the corresponding structures in the anterior margin.

The anterior and posterior regions of the sagittae include some of the most important features for discriminating species using otolith morphology. In fact, the shape of these regions reflects the presence or absence and prominence of structures such as the rostrum / postrostrum and the antirostrum / postantirostrum, or the existence of a more or less deep notch in either of the excisurae. Figure 8 shows anterior (to the right) and posterior (to the left) sections of otoliths. Ten typical shapes are defined in this Figure based on the profile of these specific regions. Some of the shapes, however, are specific to the anterior or the posterior regions.

Peaked (synonymy: pointed). The region has only one conspicuous, well developed tip that forms a clearly acute angle. The antirostrum / postantirostrum may be absent, poorly developed or clearly smaller than the rostrum / postrostrum.

Angled. The region has a very wide, short tip, which forms an almost straight or obtuse angle with an approximately median or submedian vertex.

Notched. The region has a rostrum / postrostrum and an antirostrum / postantirostrum that are very well defined, with a noticeable excisura between them.

Blunt. The region is prolonged and progressively narrower, ending in a flat tip.

Double peaked. The region has two conspicuous tips approximately similar in size. Normally, but not necessarily, they correspond to the rostrum and the antirostrum or to the postrostrum and postantiros-

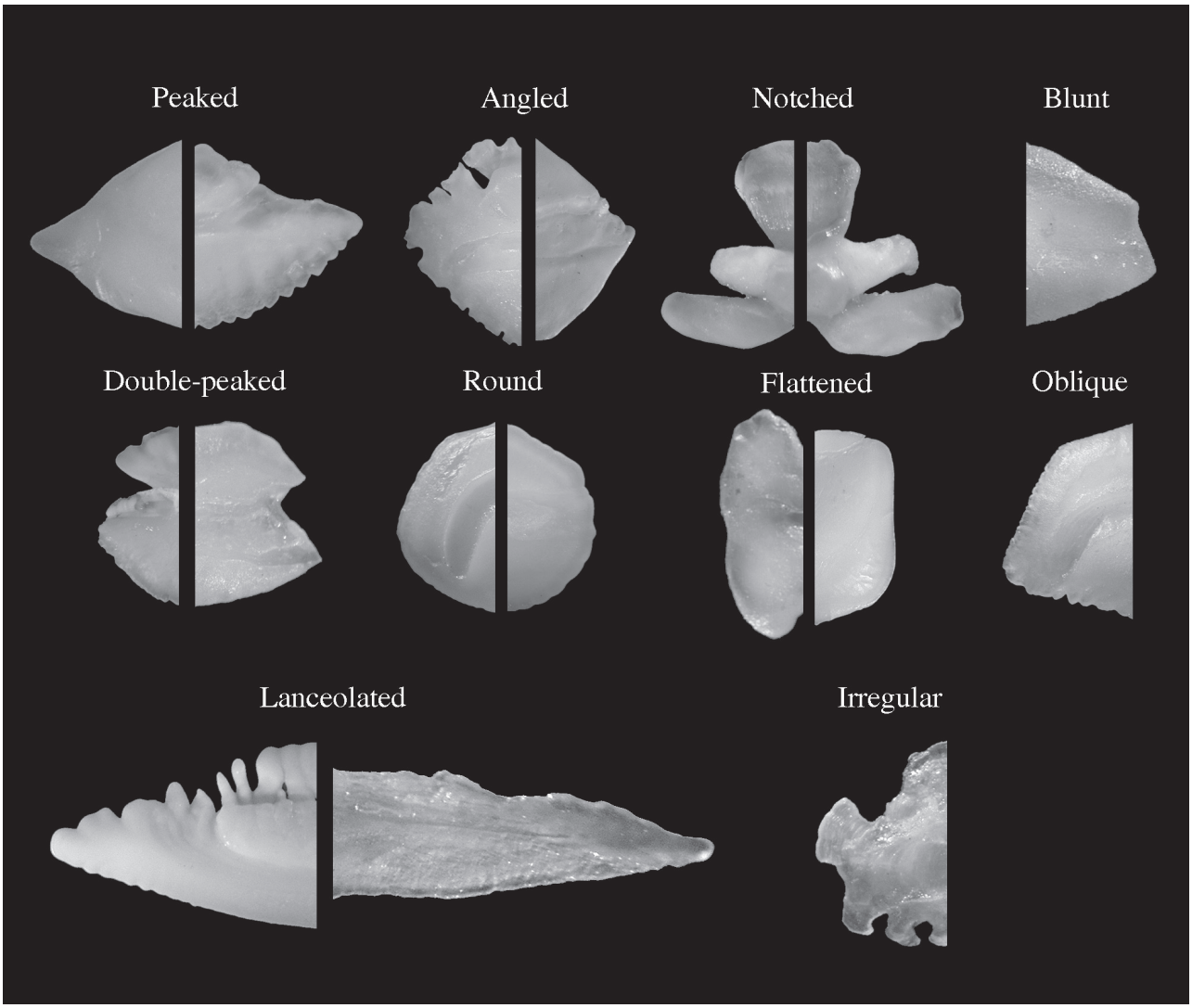

FIG. 8. – Terms used to describe the types of anterior and posterior otolith regions.

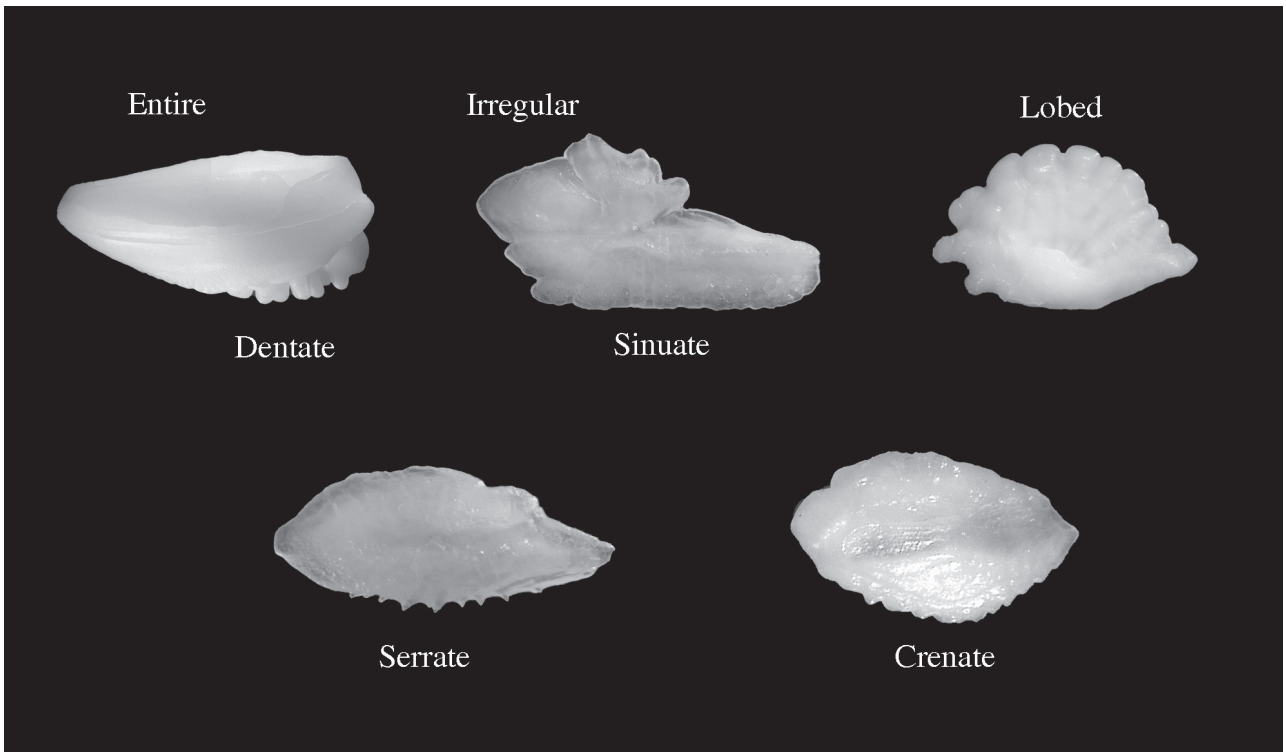

FIG. 9. – Terms used to describe the sculpture of the otolith margins.

trum (even if one of the structures is more developed than the other) separated by a clear indentation, the excisura.

Round. The region follows a more or less regular curve with an approximately median or submedian apex.

Flattened. The region is clearly flat.

Oblique. The region is more or less straight or regularly curved, but markedly asymmetrical, with the apex clearly diverted to the dorsal or the ventral region.

Lanceolated. The region is more or less symmetrical and prolonged like a lance.

Irregular. The region does not have a defined outline, and may have many irregularly distributed indentations.

Otolith margins

The outline of the otolith margins is not always smooth, and frequently has small protuberances, cuts and indentations that are useful for characterizing species. In addition, the otolith margins may be divided into sections according to the different types of marginal sculpture (Fig. 9). For the purposes of the present work, the following types of marginal sculpture are considered:

Entire. Margin or section of margin smooth, without a conspicuous sculpture.

Dentate. Margin or section of margin composed of conspicuous, round tipped and more or less fused projections, occasionally separated by very narrow and more or less deep interspaces.

Irregular. Margin or section of margin composed of conspicuous, differently shaped, irregularly spaced protuberances.

Sinuate. Margin or section of margin with a finely sinuous and more or less regular sculpture.

Lobed. Margin or section of margin composed of conspicuous and often rather large round lobes, separated by deep, acute notches.

Serrate. Margin or section of margin composed of more or less regular, conspicuous and asymmetric pointed projections, similar to the teeth of a saw.

Crenate. Margin or section of margin regularly, wavy forming more or less conspicuous round and superficial crenulations.

The morphological descriptions are presented in the following pages (Figs 10 to 96).

MORPHOLOGICAL DESCRIPTIONS

SCI. MAR., 72S1, July 2008, 7-198. ISSN 0214-8358

Order ALBULIFORMES

Notacanthus bonaparte Risso, 1840 Family NOTACANTHIDAE

Shape: discoidal, entire margins. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: round-oval, straight, ending far from the posterior margin. *Anterior region*: round to slightly peaked; rostrum very short, broad, round; antirostrum absent or very short, broad, slightly pointed in larger otoliths; excisura wide with or without a wide, shallow notch. *Posterior region*: oblique to flattened.

OL/TL	OH/OL	Circularity	Rectangularity
0.4-0.5	77.9-98.9	13.3-14.4	0.0-0.1

Polyacanthonotus rissoanus (De Filippi and Verany, 1857) Family NOTACANTHIDAE

Shape: discoidal, entire margins. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: round-oval, straight, ending far from the posterior margin. *Anterior region*: round; rostrum very short, broad, round; antirostrum absent; excisura wide without a notch. *Posterior region*: oblique.

OL/TL	OH/OL	Circularity	Rectangularity
0.5	87.0	16.4	0.1

Order ANGUILLIFORMES

Anguilla anguilla (Linnaeus, 1758) Family ANGUILLIDAE

Shape: elliptic to rectangular, ventral margin sinuate to crenate. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: tubular, straight, ending far from the posterior margin. *Anterior region*: peaked to blunt; rostrum broad, short, pointed to round; antirostrum absent or very short, broad, round; excisura very wide with a shallow notch. *Posterior region*: round.

OL/TL	OH/OL	Circularity	Rectangularity
0.3-0.7	43.2-71.5	14.4-19.3	0.2-0.4

Enchelycore anatina (Lowe, 1838) Family MURAENIDAE

Shape: elliptic to cuneiform truncated anteriorly, entire margins. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: tubular, straight, ending a little more than half way to the posterior margin. *Anterior region*: double-peaked; rostrum and antirostrum very short, broad, of similar size; excisura moderately wide with or without a shallow notch. *Posterior region*: pointed and prolonged.

OL/TL	OH/OL	Circularity	Rectangularity
0.5-0.6	31.8-55.8	16.6-18.1	0.3-0.5

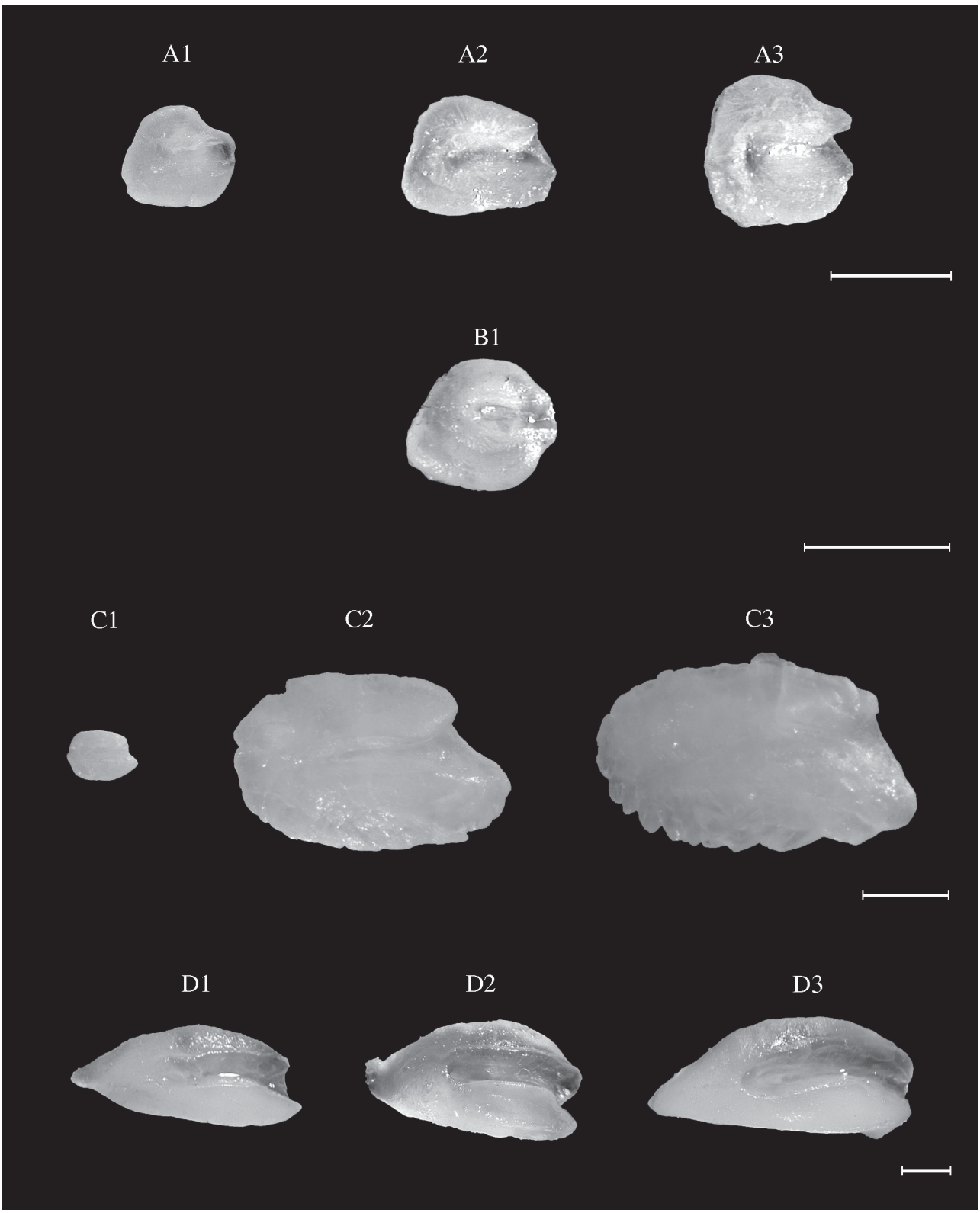

FIG. 10. – *Notacanthus bonaparte*. TL: A1, 24.9 cm (NEA); A2, 23.5 cm (WM); A3, 25.0 cm (WM).
Polyacanthonotus rissoanus (WM). TL: B1, 20.0 cm.
Anguilla anguilla (NEA). TL: C1, 12.0 cm; C2, 40.0 cm; C3, 85.7 cm.
Enchelycore anatina (CEA). TL: D1, 74.0 cm; D2, 84.5 cm; D3, 88.7 cm.
Scale bar = 1 mm.

Gymnothorax maderensis (Johnson, 1862) Family MURAENIDAE

Shape: elliptic to cuneiform truncated anteriorly, entire margins. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: tubular, straight, ending half way to the posterior margin. *Anterior region*: double-peaked or blunt; rostrum and antirostrum very short, broad, of similar size; excisura moderately wide with or without a shallow notch. *Posterior region*: pointed.

OL/TL	OH/OL	Circularity	Rectangularity
0.5	59.3-67.6	14.7-16.0	0.2-0.3

Gymnothorax polygonius Poey, 1875 Family MURAENIDAE

Shape: elliptic to cuneiform truncated anteriorly, entire margins. *Sulcus acusticus*: heterosulcoid, ostial, median to inframedian. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: tubular, straight, ending half way to the posterior margin. *Anterior region*: blunt; rostrum and antirostrum poorly defined or very short, broad, of similar size; excisura moderately wide with or without a shallow notch. *Posterior region*: round or pointed.

OL/TL	OH/OL	Circularity	Rectangularity
0.5-0.7	52.2-63.4	14.0-16.4	0.2-0.3

Gymnothorax unicolor (Delaroche, 1809) Family MURAENIDAE

Shape: elliptic to cuneiform truncated anteriorly, ventral margin crenate or entire. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: tubular, straight, ending half way to the posterior margin. *Anterior region*: double-peaked or blunt; rostrum and antirostrum of similar size, poorly defined or very short, broad, slightly pointed; excisura moderately wide with a shallow notch. *Posterior region*: round with or without an irregular end.

OL/TL	OH/OL	Circularity	Rectangularity
0.5	57.5-61.8	16.7-16.9	0.2-0.3

Muraena augusti (Kaup, 1856) Family MURAENIDAE

Shape: elliptic to cuneiform truncated anteriorly, entire margins. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like to round-oval, shorter than the cauda. *Cauda*: tubular, straight, ending half way to the posterior margin. *Anterior region*: double-peaked or blunt; rostrum and antirostrum poorly defined or very short, broad, slightly pointed, of similar size; excisura moderately wide with a shallow notch. *Posterior region*: pointed with irregular or peaked end.

OL/TL	OH/OL	Circularity	Rectangularity
5.3-7.2	49.2-52.8	16.1-16.8	0.3

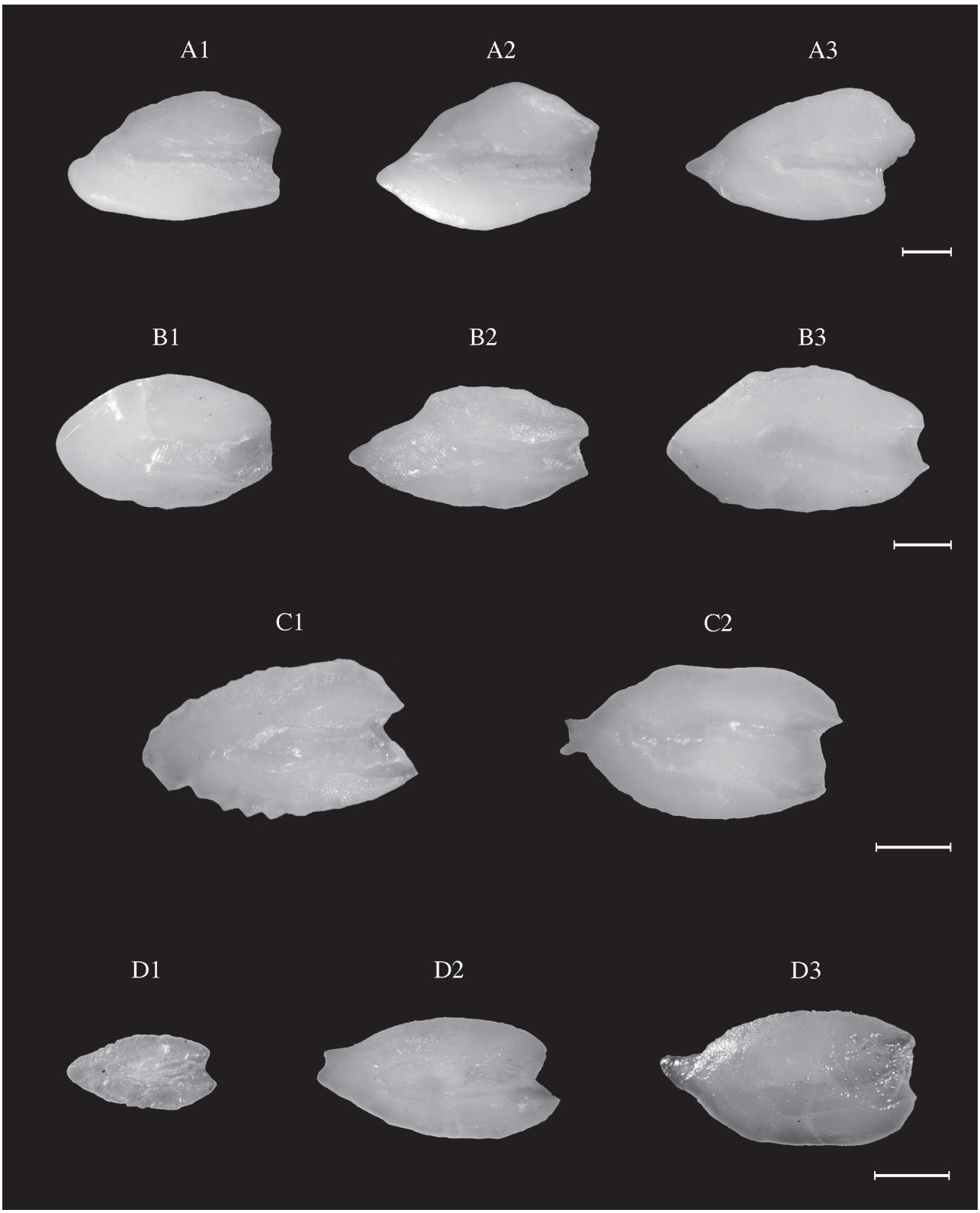

FIG. 11. – *Gymmnothorax maderensis* (CEA). TL: A1, 93.9 cm; A2, 95.5 cm; A3, 98.1 cm.
Gymmnothorax polygonius (CEA). TL: B1, 58.0 cm; B2, 61.6 cm; B3, 91.0 cm.
Gymmnothorax. unicolor (CEA). TL: C1, 70.4 cm; C2, 71.2 cm.
Muraena augusti (CEA). TL: D1, 29.8 cm; D2, 65.4 cm; D3, 66.4 cm.
Scale bar = 1 mm.

Muraena helena Linnaeus, 1758 Family MURAENIDAE

Shape: elliptic to cuneiform truncated anteriorly, entire margins. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like to round-oval, shorter than the cauda. *Cauda*: tubular, straight, ending close to the posterior margin. *Anterior region*: blunt; rostrum and antirostrum poorly defined or very short, broad, of similar size; excisura moderately wide with or without a shallow notch. *Posterior region*: pointed.

OL/TL	OH/OL	Circularity	Rectangularity
5.2-5.8	48.8-54.0	15.4-18.3	0.3-0.4

Simenchelys parasitica Gill, 1879 Family SYNAPHOBRANCHIDAE

Shape: elliptic, entire margins. *Sulcus acusticus*: heterosulcoid, mesial to para-ostial, median. *Ostium*: round to oval, shorter than the cauda. *Cauda*: tubular, straight, ending half way to the posterior margin. *Anterior region*: round, without defined features. *Posterior region*: round or slightly peaked.

OL/TL	OH/OL	Circularity	Rectangularity
0.8-0.9	51.6-62.8	14.4-16.4	0.2-0.3

Synaphobranchus affinis Günther, 1877 Family SYNAPHOBRANCHIDAE

Shape: discoidal to rhomboidal, ventral margin sinuate. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: tubular, straight, half way to the posterior margin. *Anterior region*: round to blunt; rostrum and antirostrum absent; excisura moderately wide without a notch. *Posterior region*: oblique.

OL/TL	OH/OL	Circularity	Rectangularity
0.5-0.6	74.5-81.7	13.1-14.1	0.1

Apterichtus caecus (Linnaeus, 1758) Family OPHICHTHIDAE

Shape: oval, entire margins. *Sulcus acusticus*: archaesulcoid, mesial, median. *Ostium and cauda*: undifferentiated, close to anterior margin, ending half way to the posterior margin. *Anterior region*: slightly peaked. *Posterior region*: oblique.

OL/TL	OH/OL	Circularity	Rectangularity
0.3	66.9	13.9	0.2

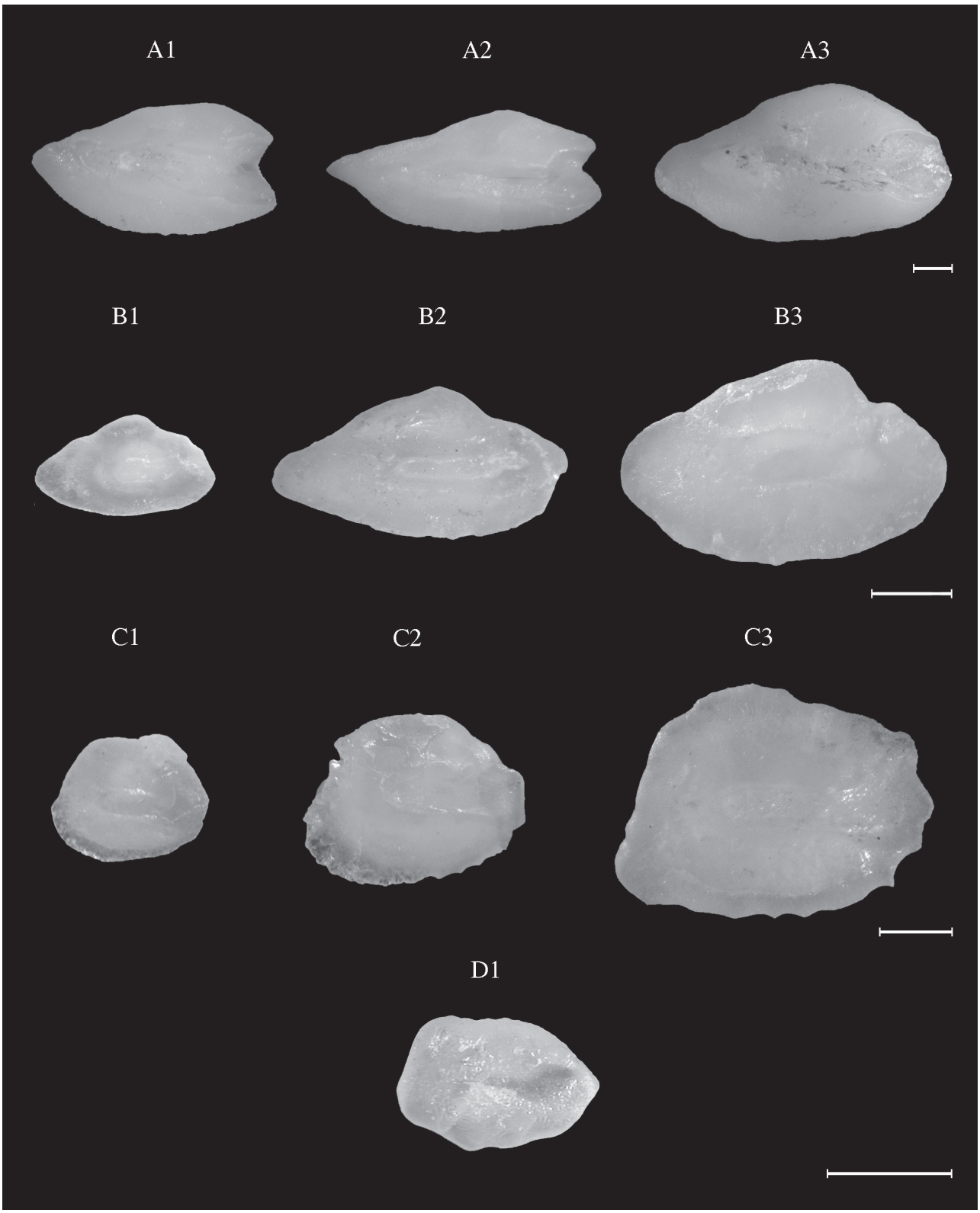

FIG. 12. – *Muraena helena* (CEA). TL: A1, 90.0 cm; A2, 95.8 cm; A3, 108.0 cm.
Simenchelys parasitica (CEA). TL: B1, 26.3 cm; B2, 43.5 cm; B3, 43.8 cm.
Syanaphobranchus affinis (CEA). TL: C1, 36.5 cm; C2, 52.4 cm; C3, 70.0 cm.
Apterichtus caecus (WM). TL: D1, 42.5 cm.
Scale bar = 1 mm.

Echelus myrus (Linnaeus, 1758) Family OPHICHTHIDAE

Shape: oval, entire margins. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: tubular, straight, ending half way to the posterior margin. *Anterior region*: peaked; rostrum short, broad, pointed; antirostrum very short, broad, pointed; excisura wide with an acute, shallow notch. *Posterior region*: round.

OL/TL	OH/OL	Circularity	Rectangularity
1.0	53.1	15.2	0.3

Ophichthus rufus (Rafinesque, 1810) Family OPHICHTHIDAE

Shape: oval to elliptic. *Sulcus acusticus*: heterosulcoid, mesial, median or supramedian. *Ostium*: round to oval, shorter than the cauda. *Cauda*: tubular, straight, ending half way to the posterior margin. *Anterior region*: round. *Posterior region*: round.

OL/TL	OH/OL	Circularity	Rectangularity
0.6	58.4-61.2	13.9-14.7	0.2-0.3

Ophisurus serpens (Linnaeus, 1758) Family OPHICHTHIDAE

Shape: elliptic, entire margins. *Sulcus acusticus*: heterosulcoid, pseudo-ostial, median. *Ostium*: round to oval, shorter than the cauda. *Cauda*: tubular, straight, ending half way to the posterior margin. *Anterior region*: slightly pointed. *Posterior region*: pointed.

OL/TL	OH/OL	Circularity	Rectangularity
0.3	48.6	15.6	0.4

Coloconger cadenati Kanazawa, 1961 Family COLOCONGRIDAE

Shape: kidney-shaped, dorsally concave, entire margins. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: tubular, slightly concave dorsally, ending very far from the posterior margin. *Anterior region*: double-peaked; rostrum very short, broad, pointed; antirostrum similar to the rostrum but smaller; excisura very narrow with a superficial notch. *Posterior region*: round.

OL/TL	OH/OL	Circularity	Rectangularity
2.6	55.8	17.2	0.4

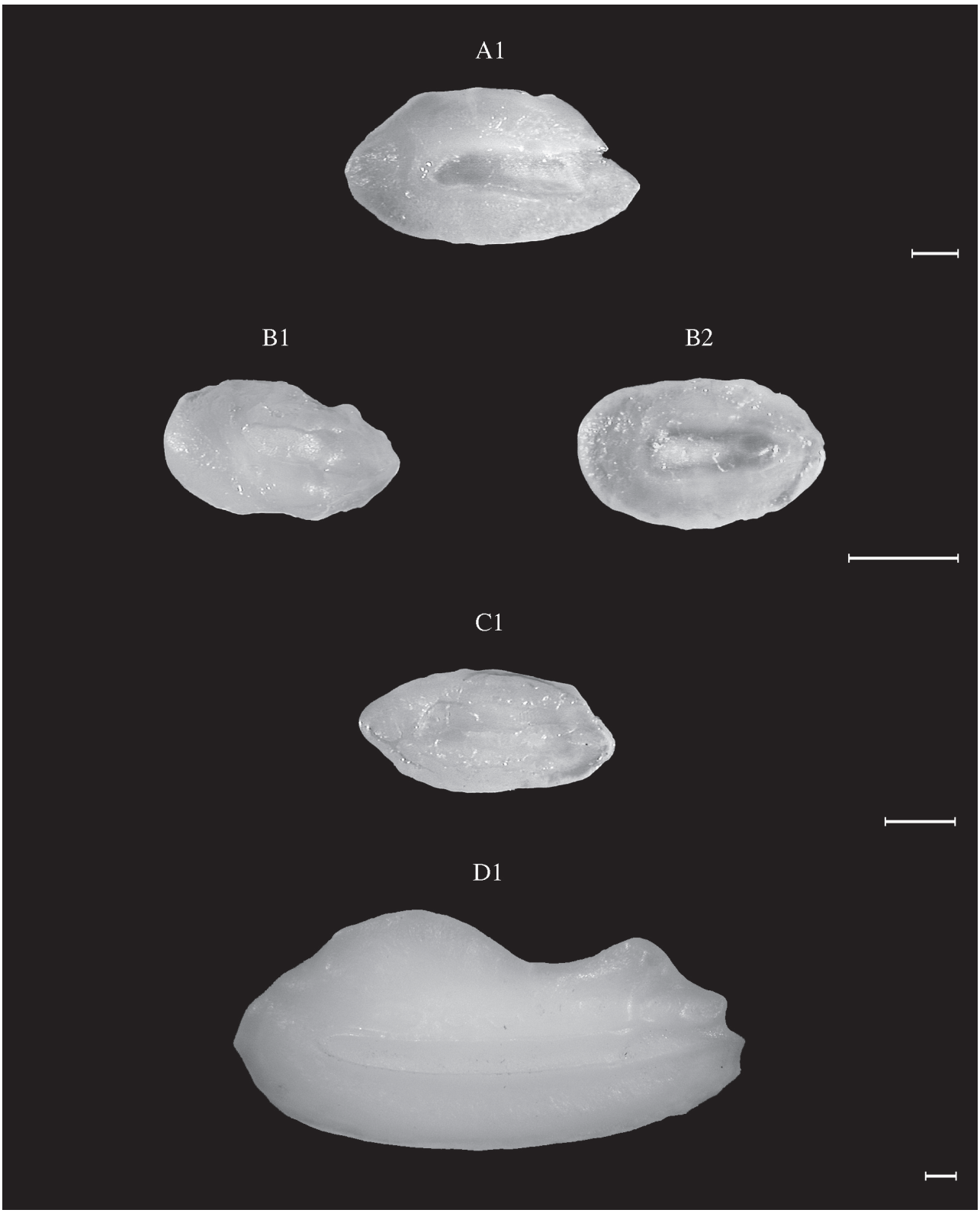

FIG. 13. – *Echelus myrus* (WM). TL: A1, 62.0 cm.
Ophichthus rufus (WM). TL: B1, 35.0 cm; B2, 39.5 cm.
Ophisurus serpens (WM). TL: C1, 140.0 cm.
Coloconger cadenati (CEA). TL: D1, 63.3 cm.
Scale bar = 1 mm.

Nemichthys scolopaceus Richardson, 1848 Family NEMICHTHYIDAE

Shape: squared, entire margins. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: tubular, straight, ending half way to the posterior margin. *Anterior region*: flattened; rostrum poorly defined, very short, broad; antirostrum absent; excisura wide without a notch. *Posterior region*: flattened.

OL/TL	OH/OL	Circularity	Rectangularity
0.1	88.9	14.0	0.1

Ariosoma balearicum (Delaroche, 1809) Family CONGRIDAE

Shape: oval to discoidal, entire margins. *Sulcus acusticus*: heterosulcoid, para-ostial, supramedian. *Ostium*: shorter than the cauda, opening in the lateral-dorsal margin. *Cauda*: tubular, straight, ending half way to the posterior margin. *Anterior region*: round; rostrum short, broad, round; antirostrum asbent; excisura a channel. *Posterior region*: angled.

OL/TL	OH/OL	Circularity	Rectangularity
1.9	81.7	13.34	0.01

Conger conger (Linnaeus, 1758) Family CONGRIDAE

Shape: oblong, dorsal and posterior margins entire to irregular. *Sulcus acusticus*: homosulcoid, mesial to para-ostial, median to slightly inframedian. *Ostium and cauda*: elliptic, straight, broad, separated by a slight constriction, cauda longer than the ostium. *Anterior region*: round. *Posterior region*: oblique to irregular.

OL/TL	OH/OL	Circularity	Rectangularity
1.3-1.9	37.0-37.9	18.8-24.7	0.5

Gnathophis mystax (Delaroche, 1809) Family CONGRIDAE

Shape: rhomboidal, posterior-dorsal margin notched. *Sulcus acusticus*: heterosulcoid, ostial, inframedian. *Ostium*: funnel-like, as long as the cauda. *Cauda*: tubular, straight, ending a little more than half way to the posterior margin. *Anterior region*: angled; rostrum short, broad, round; antirostrum absent; excisura very wide without a notch. *Posterior region*: angled.

OL/TL	OH/OL	Circularity	Rectangularity
2.3-2.8	62.1-64.2	14.4	0.2

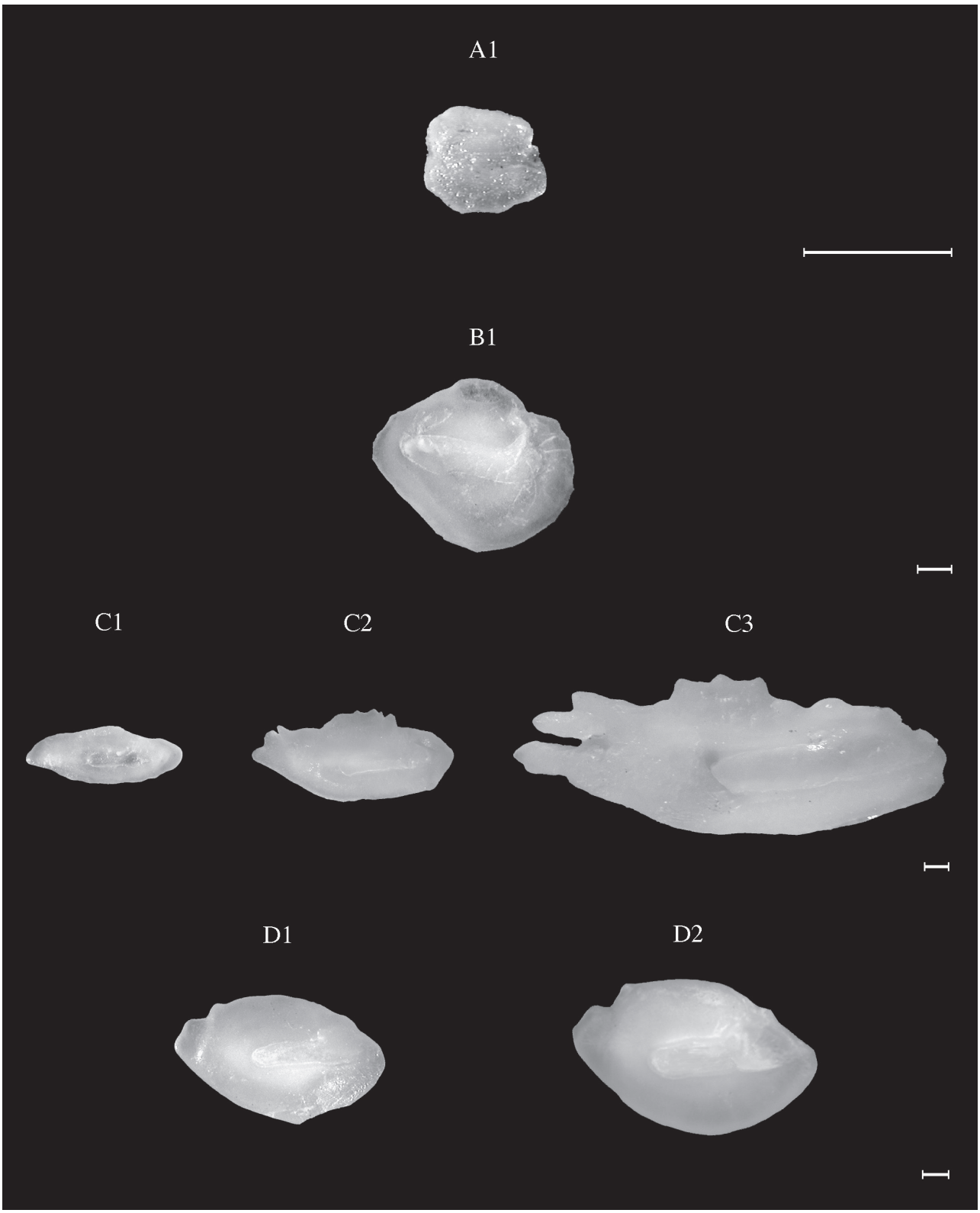

FIG. 14. – *Nemichthys scolopaceus* (WM). TL: A1, 86.0 cm.
Ariosoma balearicum (WM). TL: B1, 29.5 cm.
Conger conger. TL: C1, 33.0 cm (WM); C2, 77.9 cm (NEA); C3, 136.0 cm (CEA).
Gnathophis mystax (WM). TL: D1, 27.0 cm; D2, 38.0 cm.
Scale bar = 1 mm.

Facciolella oxyrhyncha (Bellotti, 1883) Family NETTASTOMATIDAE

Shape: elliptic, entire margins. *Sulcus acusticus*: archaesulcoid, mesial, slighly inframedian. *Ostium and cauda*: undifferentiated, elliptic, straight, close to anterior margin, ending very far from the posterior margin. *Anterior region*: round. *Posterior region*: round.

OL/TL	OH/OL	Circularity	Rectangularity
0.5	43.3	17.4	0.4

Nettastoma melanurum Rafinesque, 1810 Family NETTASTOMATIDAE

Shape: elliptic, entire margins. *Sulcus acusticus*: archaesulcoid, mesial, median or slightly inframedian. *Ostium and cauda*: undifferentiated, elliptic, straight, close to anterior margin and ending far from posterior margin. *Anterior region*: round. *Posterior region*: round.

OL/TL	OH/OL	Circularity	Rectangularity
1.0	55.0-60.8	14.2-14.8	0.2-0.3

Order CLUPEIFORMES

Engraulis encrasicolus (Linnaeus, 1758) Family ENGRAULIDAE

Shape: elliptic, ventral margin serrated in the larger otoliths. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, longer than the cauda. *Cauda*: tubular, straight, ending far from the posterior margin. *Anterior region*: peaked; rostrum short, broad, pointed; antirostrum short, broad, peaked or poorly defined in the larger otoliths; excisura wide with a shallow, acute notch or without a notch in the larger otoliths. *Posterior region*: round or slightly pointed.

OL/TL	OH/OL	Circularity	Rectangularity
2.1-2.5	42.5-46.3	17.4-19.2	0.4

Alosa alosa (Linnaeus, 1758) Family CLUPEIDAE

Shape: elliptic, irregular outline in the dorsal and posterior margins. *Sulcus acusticus*: pseudo-archaesulcoid, ostial, median. *Ostium*: funnel-like, longer than the cauda. *Cauda*: tubular, straight, ending far from the posterior margin. *Anterior region*: peaked; rostrum broad, larger with otolith growth, pointed; antirostrum short, broad, round to irregular; excisura very wide with a shallow, acute notch. *Posterior region*: round to angled with supramedian apex in the larger otoliths.

OL/TL	OH/OL	Circularity	Rectangularity
1.0-1.2	51.4-52.3	18.2-20.5	0.3

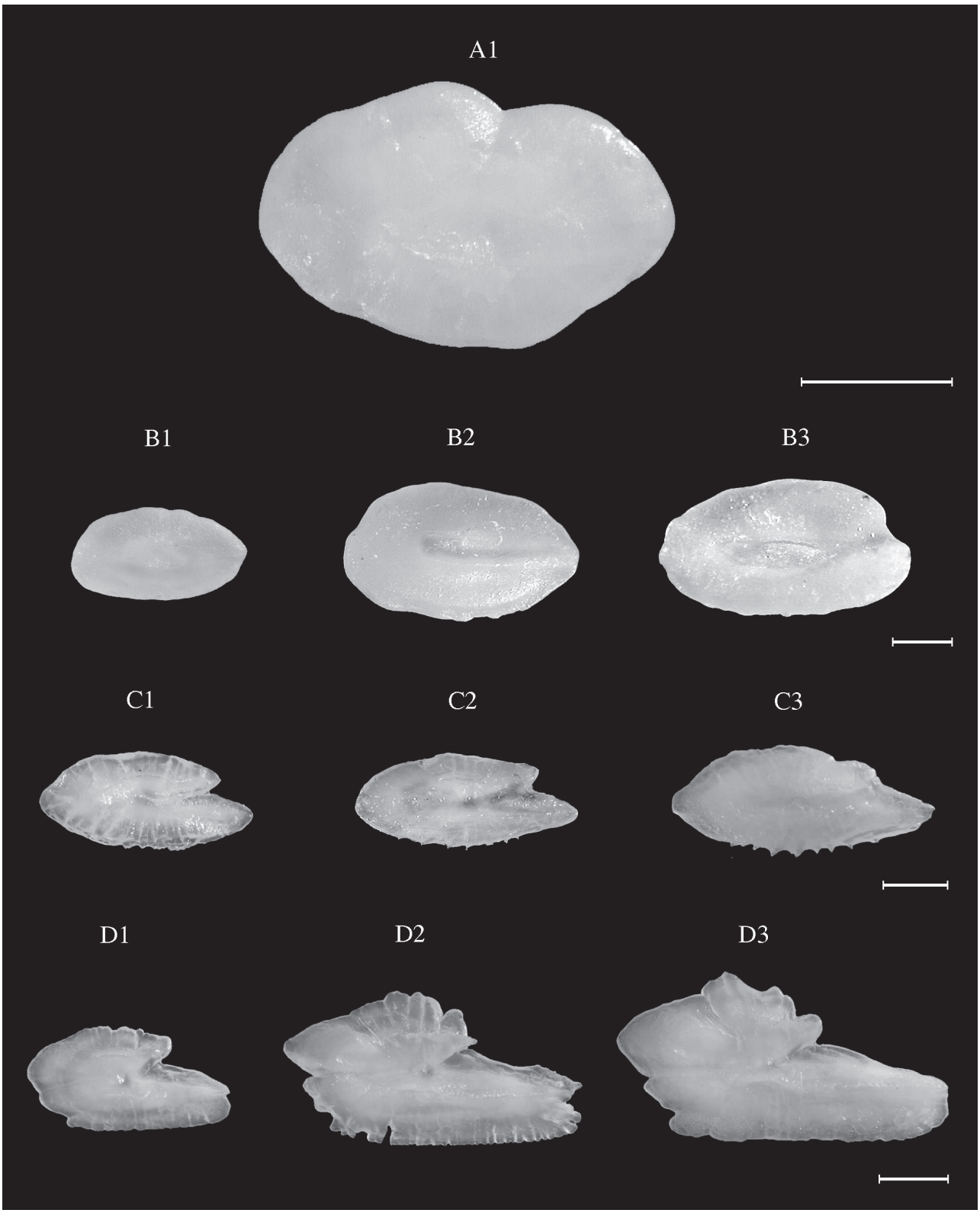

FIG. 15. – *Facciolella oxyrhyncha* (NEA). TL: A1, 59.0 cm.
Nettastoma melanurum. TL: B1, 36.0 cm (NEA) B2, 52.0 cm (WM); B3, 56.0 cm (WM).
Engraulis encrasicolus. TL: C1, 13.4 cm (CEA); C2, 15.5 cm (WM); C3, 17.7 cm (NEA).
Alosa alosa (NEA). TL: D1, 25.6 cm; D2, 42.2 cm; D3, 67.5 cm.
Scale bar = 1 mm.

Alosa fallax (Lacepède, 1803) Family CLUPEIDAE

Shape: elliptic, deep indentations in the larger otoliths. *Sulcus acusticus*: pseudo-archaesulcoid, ostial, median. *Ostium*: funnel-like, longer than the cauda. *Cauda*: tubular, straight, ending far from the posterior margin. *Anterior region*: peaked; rostrum broad, larger with otolith growth, blunt or pointed; antirostrum short, broad, round to irregular; excisura very wide with a conspicuous round or shallow notch. *Posterior region*: round to angled with a supramedian apex in the larger otoliths.

OL/TL	OH/OL	Circularity	Rectangularity
1.0-1.4	45.5-53.6	18.1-24.7	0.3-0.4

Sardina pilchardus (Walbaum, 1792) Family CLUPEIDAE

Shape: elliptic, ventral margin dentated. *Sulcus acusticus*: pseudo-archaesulcoid, ostial, median. *Ostium*: funnel-like, longer than the cauda. *Cauda*: tubular, straight, ending far from the posterior margin. *Anterior region*: peaked; rostrum broad, long, pointed; antirostrum larger with otolith growth, broad, pointed; excisura wide with a deep, acute notch. *Posterior region*: round to angled with supramedian apex in the larger otoliths.

OL/TL	OH/OL	Circularity	Rectangularity
1.8-2.0	45.5-48.7	19.5-24.1	0.3-0.4

Sardinella aurita Valenciennes, 1847 Family CLUPEIDAE

Shape: elliptic, ventral margin dentated, dorsal margin also dentated in the larger otoliths. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, longer than the cauda. *Cauda*: tubular, straight, ending far from the posterior margin. *Anterior region*: peaked; rostrum broad, long, pointed; antirostrum larger with otolith growth, broad, pointed; excisura wide with a deep, acute notch. *Posterior region*: round with supramedian apex in the larger otoliths.

OL/TL	OH/OL	Circularity	Rectangularity
1.6-2.3	45.0-49.3	22.3-24.3	0.4-0.5

Sardinella maderensis (Lowe, 1838) Family CLUPEIDAE

Shape: elliptic, with ventral margin dentated. *Sulcus acusticus*: heterosulcoid, ostial, median *Ostium*: funnel-like, longer than the cauda. *Cauda*: tubular, straight, ending far from the posterior margin. *Anterior region*: peaked; rostrum broad, long, pointed; antirostrum broad, short, pointed; excisura wide with a deep, acute notch. *Posterior region*: round to irregular.

OL/TL	OH/OL	Circularity	Rectangularity
1.8	46.3	23.6	0.4

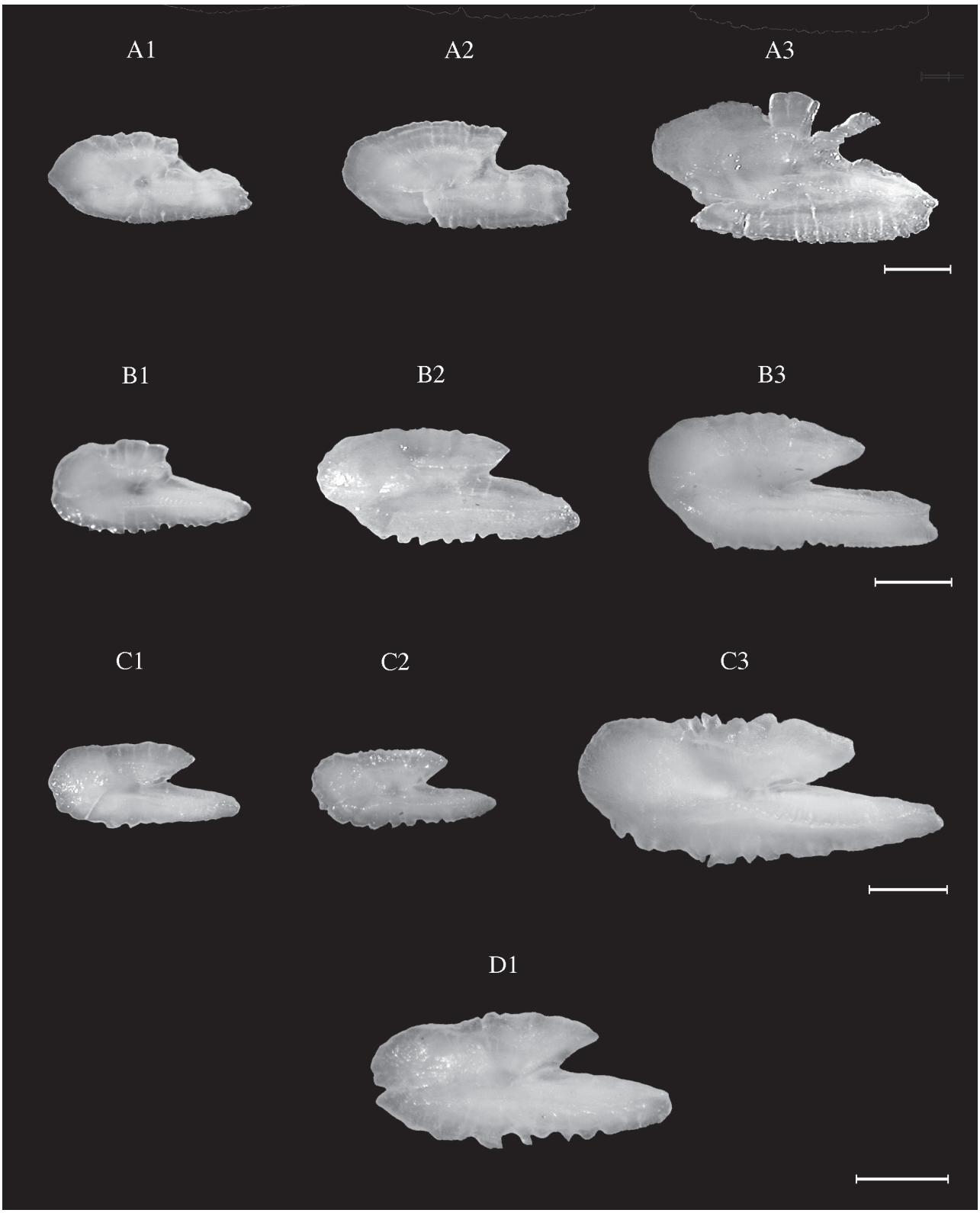

FIG. 16. – *Alosa fallax.* TL: A1, 21.9 cm (NEA); A2, 27.6 cm (NEA); A3, 43.5 cm (WM).
Sardina pilchardus. TL: B1, 13.8 cm (CEA); B2, 17.5 cm (WM); B3, 21.4 cm (NEA).
Sardinella aurita. TL: C1, 12.5 cm (WM); C2, 13.2 cm (CEA); C3, 30.0 cm (NEA).
Sardinella maderensis (CEA). TL: D1, 18.3 cm.
Scale bar = 1 mm.

Sprattus sprattus (Linnaeus, 1758) Family CLUPEIDAE

Shape: elliptic, ventral margin crenate. *Sulcus acusticus*: pseudo-archaesulcoid, ostial, median. *Ostium*: funnel-like, longer than the cauda. *Cauda*: tubular, straight, ending far from the posterior margin. *Anterior region*: peaked; rostrum very broad, short, round; antirostrum very short, broad, round; excisura wide with a shallow notch. *Posterior region*: round.

OL/TL	OH/OL	Circularity	Rectangularity
1.6	61.7	16.0	0.2

Order ARGENTINIFORMES

Argentina sphyraena Linnaeus, 1758 Family ARGENTINIDAE

Shape: pentagonal, slightly longer than tall, irregular dorsal and posterior margins. *Sulcus acusticus*: heterosucloid, ostial, supramedian. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: tubular, straight, ending close to the posterior margin. *Anterior region*: peaked; rostrum long, broad, triangular, pointed; antirostrum absent; excisura very wide without a notch. *Posterior region*: flattened to round.

OL/TL	OH/OL	Circularity	Rectangularity
2.8-3.5	61.4-73.4	16.3-19.0	0.2

Glossanodon leioglossus (Valenciennes, 1848) Family ARGENTINIDAE

Shape: pentagonal, longer than tall, with irregular dorsal margin. *Sulcus acusticus*: heterosucloid, ostial, supremedian. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: tubular, straight, ending close to the posterior margin. *Anterior region*: peaked; rostrum long, broad, triangular, pointed; antirostrum absent; excisura very wide without a notch. *Posterior region*: flattened-oblique.

OL/TL	OH/OL	Circularity	Rectangularity
4.1-4.2	59.6-65.4	16.4-17.2	0.2-0.3

Alepocephalus rostratus Risso, 1820 Family ALEPOCEPHALIDAE

Shape: triangular (triangle-rectangle), dorsal region more irregular and deeply indented with growth. *Sulcus acusticus*: heterosucloid, ostial, median. *Ostium*: funnel-like, longer than the cauda. *Cauda*: tubular, straight, ending in the medial region. *Anterior region*: peaked; rostrum long, broad, pointed; antirostrum absent or small, broad, round; excisura very wide with a shallow or deep, acute notch. *Posterior region*: flattened to round.

OL/TL	OH/OL	Circularity	Rectangularity
1.9-3.9	61.8-72.3	16.3-21.7	0.2

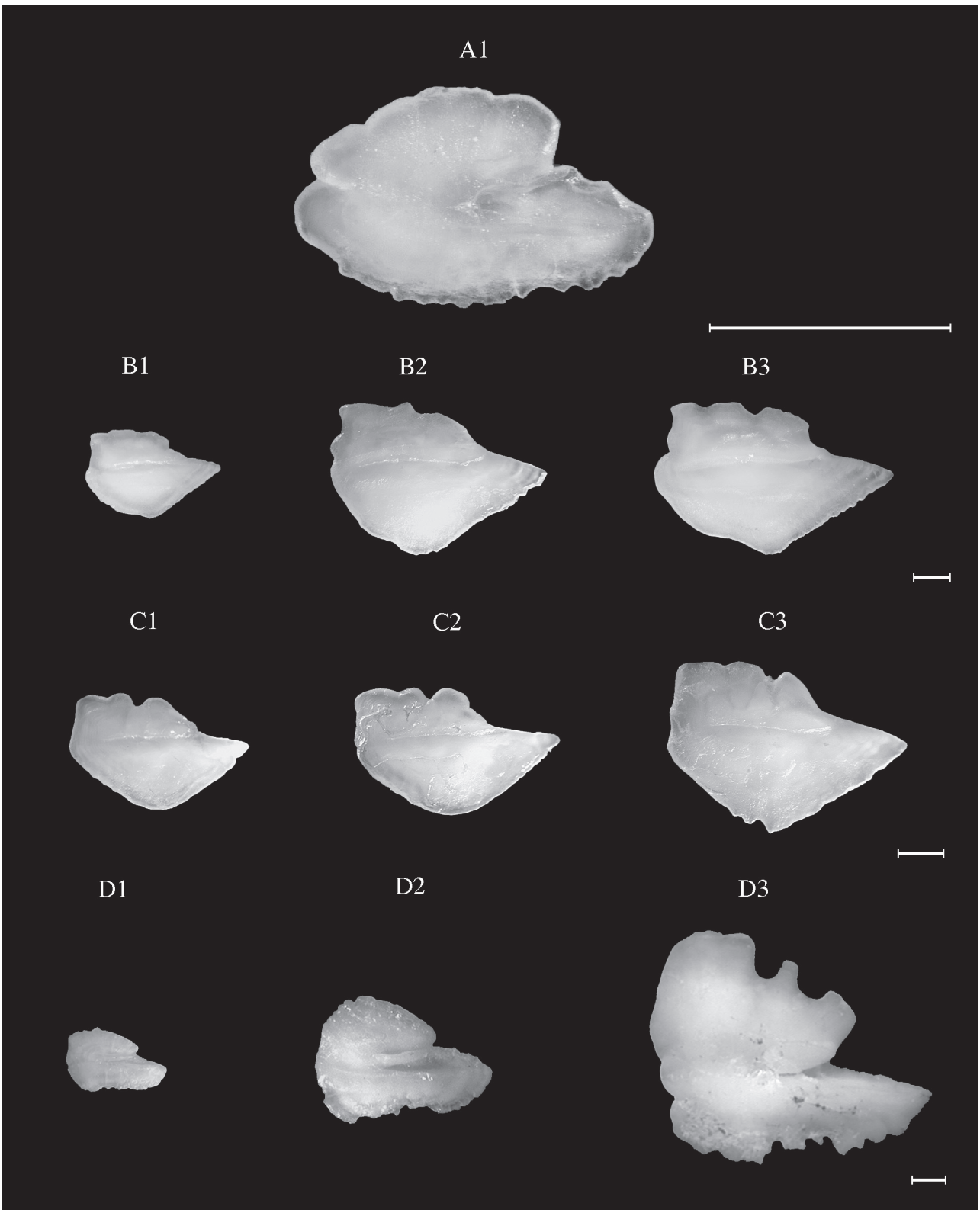

FIG. 17. – *Sprattus sprattus* (NEA). TL: A1, 9.3 cm.
Argentina sphyraena. TL: B1, 11.9 cm (NEA); B2, 17.0 cm (WM); B3, 22.6 cm (NEA).
Glossanodon leioglossus (WM). TL: C1, 9.0 cm; C2, 10.5 cm; C3, 12.5 cm.
Alepocephalus rostratus (WM). TL: D1, 7.5 cm; D2, 19.0 cm; D3, 44.0 cm.
Scale bar = 1 mm.

Order STOMIIFORMES

Gonostoma denudatum Rafinesque, 1810 Family GONOSTOMATIDAE

Shape: pyriform. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, longer than the cauda. *Cauda*: tubular, slightly curved to the dorsal area, ending in the middle of the posterior half of the otolith. *Anterior region*: lanceolated; rostrum short to long, narrow, pointed, slightly flexed to the dorsal area, with crenated margins; antirostrum absent or poorly defined; excisura wide without a notch. *Posterior region*: round to flattened.

OL/TL	OH/OL	Circularity	Rectangularity
2.3-3.0	41.0-76.0	16.1-25.4	0.1-0.4

Gonostoma elongatum Günther, 1878 Family GONOSTOMATIDAE

Shape: pyriform. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, longer than the cauda. *Cauda*: tubular, slightly curved to the ventral area, ending in the middle of the posterior half of the otolith. *Anterior region*: lanceolated; rostrum long, narrow, pointed; antirostrum poorly defined; excisura wide without a notch. *Posterior region*: round to angled.

OL/TL	OH/OL	Circularity	Rectangularity
1.2-1.3	49.6-57.9	19.4-21.8	0.3

Argyropelecus aculeatus Valenciennes, 1850 Family STERNOPTYCHIDAE

Shape: tall. *Sulcus acusticus*: heterosulcoid, ostio-caudal, median. *Ostium*: discoidal, shorter than the cauda. *Cauda*: tubular, strongly curved to the ventral area. *Anterior region*: flattened; rostrum and antirostrum poorly defined, very short, broad, round; excisura wide without a notch. *Posterior region*: flattened.

OL/TL	OH/OL	Circularity	Rectangularity
0.9-1.2	148.3-179.7	14.7-16.8	-0.2-(0.3)

Argyropelecus hemigymnus Cocco, 1829 Family STERNOPTYCHIDAE

Shape: tall. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: tubular, slightly curved to the ventral area. *Anterior region*: flattened; rostrum and antirostrum poorly defined, very short, broad, round; excisura wide without a notch. *Posterior region*: flattened-round.

OL/TL	OH/OL	Circularity	Rectangularity
1.4-1.5	128.2-131.1	14.4-15.8	-0.1

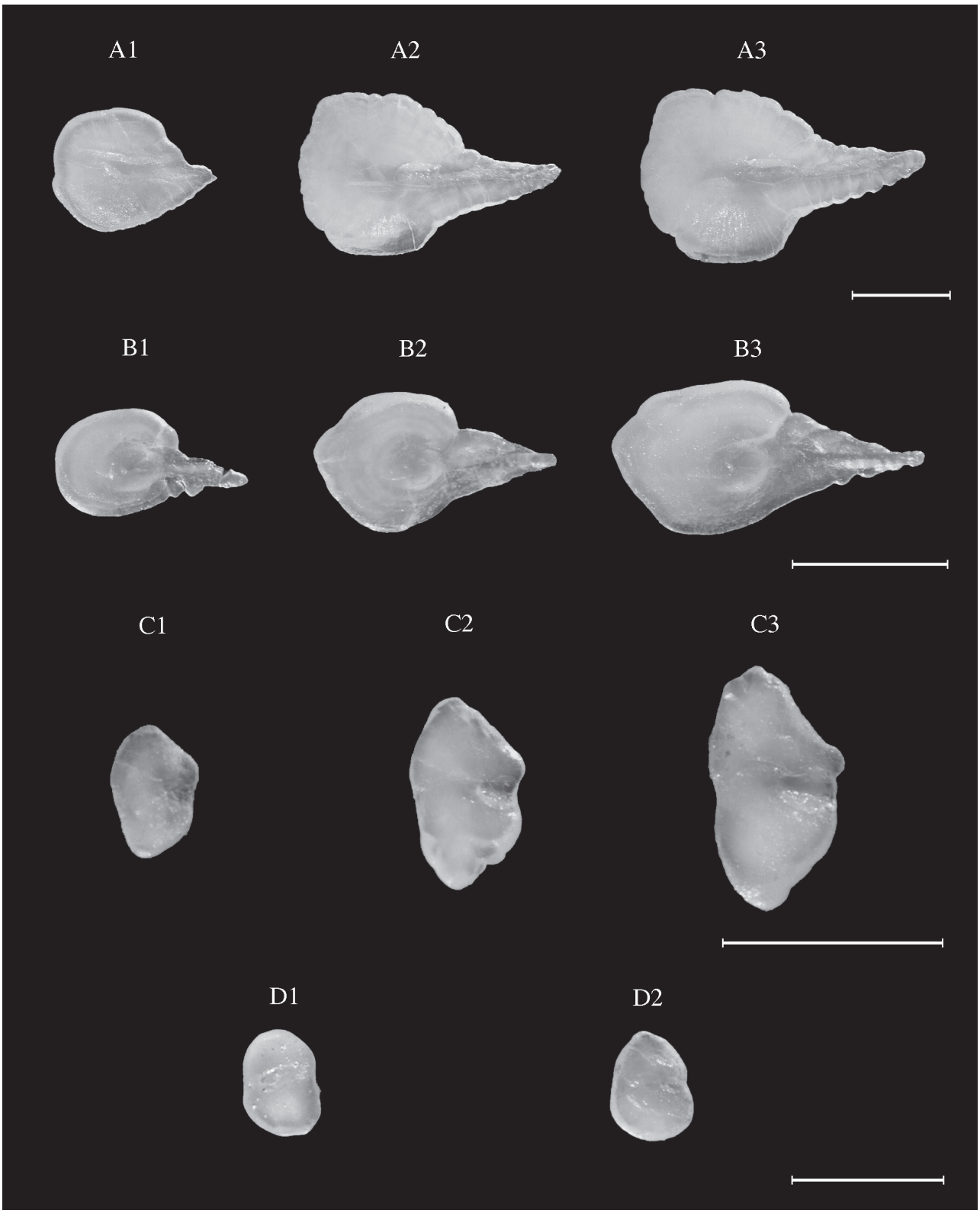

FIG. 18. – *Gonostoma denudatum* (NEA). TL: A1, 7.4 cm; A2, 9.2 cm; A3, 10.0 cm. *Gonostoma elongatum* (NEA). TL: B1, 10.2 cm; B2, 12.9 cm; B3, 15.7 cm. *Argyropelecus aculeatus* (NEA). TL: C1, 3.5 cm; C2, 5.0 cm; C3, 6.9 cm. *Argyropelecus hemigymnus*. TL: D1, 3.8 cm (WM); D2, 3.9 cm (NEA). Scale bar = 1 mm.

Maurolicus muelleri (Gmelin, 1789) Family STERNOPTYCHIDAE

Shape: pyriform, dorsal and ventral margins irregular. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, longer than the cauda. *Cauda*: tubular, straight, ending far from the posterior margin. *Anterior region*: lanceolated; *rostrum* long, narrow, pointed; *antirostrum* short, broad, round; *excisura* wide with a shallow or deep, acute notch. *Posterior region*: angled to round.

OL/TL	OH/OL	Circularity	Rectangularity
3.9-4.1	73.0-81.6	20.8-22.9	0.1-0.2

Polymetme corythaeola (Alcok, 1898) Family PHOSICHTHYIDAE

Shape: pyriform, ventral margin crenated in the larger otoliths. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, similar to the cauda in size. *Cauda*: tubular, straight, ending far from the posterior margin. *Anterior region*: lanceolated; rostrum long, narrow, pointed; antirostrum absent; excisura wide without a notch. *Posterior region*: round.

OL/TL	OH/OL	Circularity	Rectangularity
1.8-1.9	39.4-56.0	17.9-24.5	0.2-0.4

Chauliodus sloani Bloch and Schneider, 1801 Family STOMIIDAE

Shape: discoidal. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, longer than the cauda. *Cauda*: tubular, straight, ending far from the posterior margin. *Anterior region*: round; rostrum very short, broad, round; antirostrum absent; excisura wide without a notch. *Posterior region*: round.

OL/TL	OH/OL	Circularity	Rectangularity
0.6	80.7-81.6	15.3-15.5	0.1

Stomias boa (Risso, 1810) Family STOMIIDAE

Shape: oval. *Sulcus acusticus*: archaesulcoid, ostial, median. *Ostium* and *cauda*: narrow, straight without a constriction between them, ending very far from the posterior margin. *Anterior region*: round; rostrum poorly defined, very short, broad, round; antirostrum absent or poorly defined; excisura wide without a notch. *Posterior region*: round.

OL/TL	OH/OL	Circularity	Rectangularity
0.5-0.6	69.0-76.1	15.3-15.7	0.1-0.2

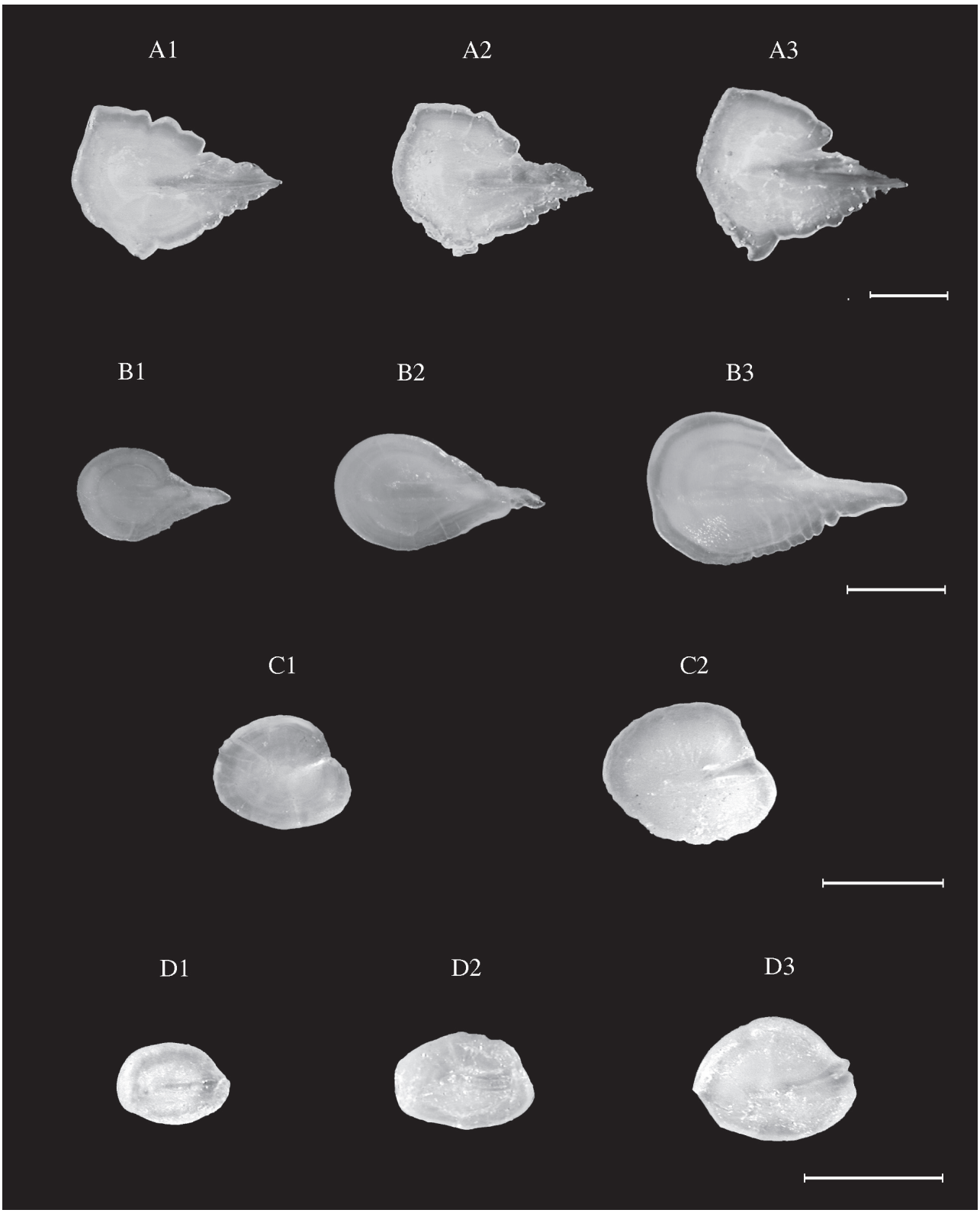

FIG. 19. – *Maurolicus muelleri* (WM). TL: A1, 5.0 cm; A2, 5.0 cm; A3, 5.0 cm.
Polymetme corythaeola (NEA). TL: B1, 10.2 cm; B2, 14.2 cm; B3, 16.4 cm.
Chauliodus sloani (WM). TL: C1, 18.5 cm; C2, 23.0 cm.
Stomias boa (WM). TL: D1, 14.0 cm; D2, 19.0 cm; D3, 21.0 cm.
Scale bar = 1 mm.

Order AULOPIFORMES

Aulopus filamentosus (Bloch, 1792) Family AULOPIDAE

Shape: oblong, with a prolonged posterior-dorsal region, dorsal and posterior margins irregular. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: tubular, curved, slightly or strongly flexed posteriorly, ending close to the posterior-ventral margin, straight. *Anterior region*: peaked; rostrum short to long, broad, pointed to lancelolated, slightly flexed to the dorsal region; antirostrum absent; excisura wide without a notch or with a shallow, obtuse notch. *Posterior region*: irregular, more developed dorsally than ventrally.

OL/TL	OH/OL	Circularity	Rectangularity
2.1-2.8	39.5-47.5	17.2-20.7	0.4

Synodus saurus (Linnaeus, 1758) Family SYNODONTIDAE

Shape: cuneiform to rectangular. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: tubular, higher than the ostium, curved, strongly flexed from the middle region, ending close to the posterior margin. *Anterior region*: peaked to double-peaked; rostrum long, broad to narrow, pointed, longer with growth; antirostrum absent or long, narrow, pointed; excisura wide with or without an acute, deep notch in the larger specimens. *Posterior region*: round to oblique, irregular.

OL/TL	OH/OL	Circularity	Rectangularity
1.0-1.5	48.3-60.1	16.2-24.8	0.3-0.4

Synodus synodus (Linnaeus, 1758) Family SYNODONTIDAE

Shape: rectangular. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: tubular, curved, strongly flexed from the middle region, ending close to the posterior margin. *Anterior region*: peaked; rostrum short or long, broad, pointed; antirostrum poorly defined or short, broad, round; excisura wide with or without a shallow notch. *Posterior region*: round to oblique, irregular.

OL/TL	OH/OL	Circularity	Rectangularity
1.1-1.6	51.0-57.0	16.8-18.9	0.3

Chlorophthalmus agassizi Bonaparte, 1840 Family CLOROPHTHALMIDAE

Shape: oblong. *Sulcus acusticus*: heterosulcoid, ostial, supramedian. *Ostium*: poorly defined, funnel-like, shorter than the cauda. *Cauda*: tubular, higher than the ostium, curved, slightly flexed posteriorly, ending close to the posterior-dorsal margin. *Anterior region*: round; rostrum and antirostrum absent or poorly defined; excisura wide without a notch. *Posterior region*: round.

OL/TL	OH/OL	Circularity	Rectangularity
3.0-4.6	41.4-45.7	16.7-17.4	0.4

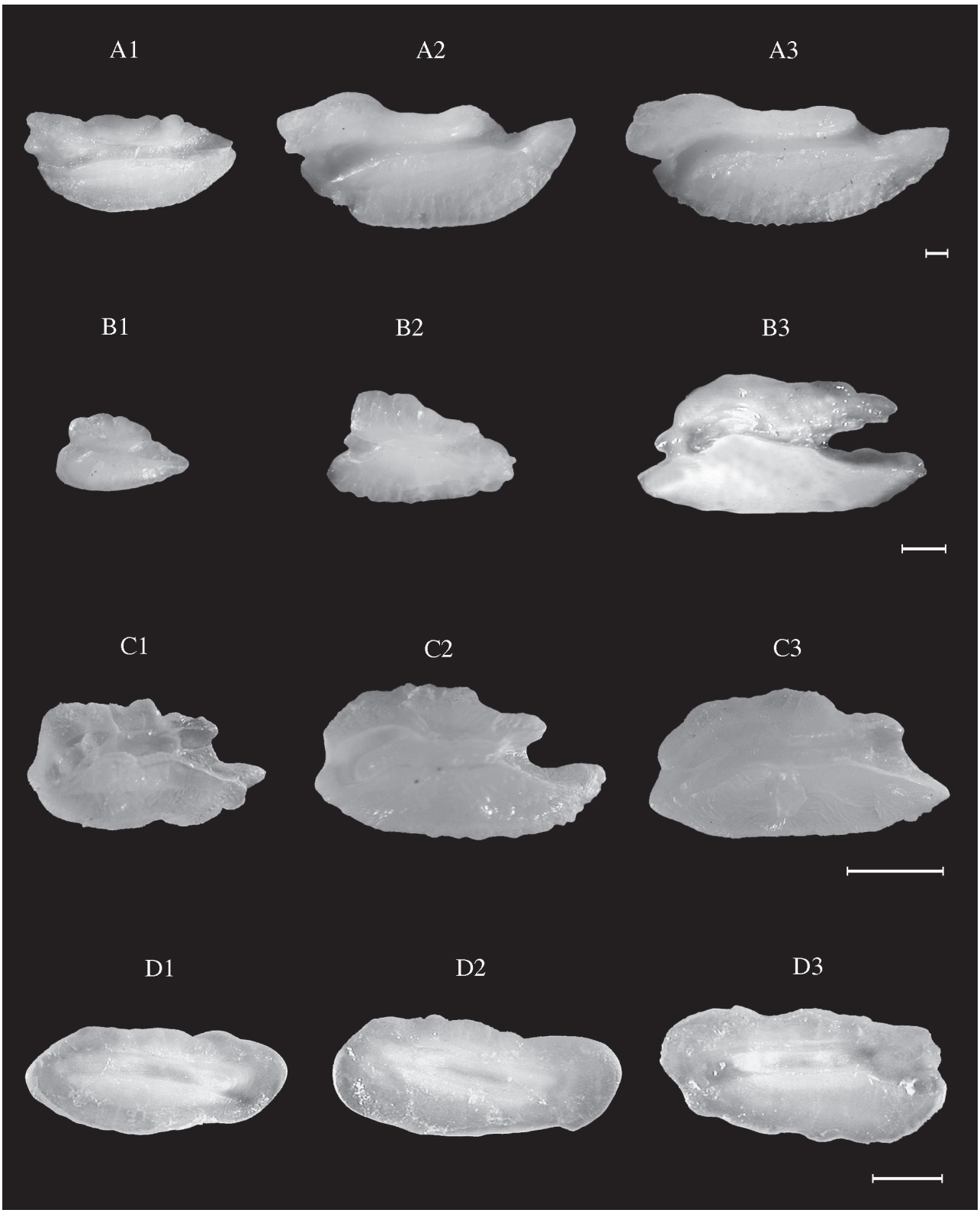

FIG. 20. – *Aulopus filametosus*. TL: A1, 21.0 cm (WM); A2, 34.0 cm (CEA); A3, 42.3 cm (CEA).
Synodus saurus. TL: B1, 18.2 cm (CEA); B2, 31.9 cm (CEA); B3, 42.0 cm (WM).
Synodus synodus (CEA). TL: C1, 19.7 cm; C2, 22.3 cm; C3, 22.5 cm.
Chlorophthalmus agassizi (WM). TL: D1, 8.0 cm; D2, 9.0 cm; D3, 13.5 cm.
Scale bar = 1 mm.

Bathypterois mediterraneus Vaillant, 1888 Family IPNOPIDAE

Shape: elliptic. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: tubular, straight, ending far from the posterior margin. *Anterior region*: peaked; rostrum short, broad, round to pointed; antirostrum absent; excisura wide without a notch. *Posterior region*: round.

OL/TL	OH/OL	Circularity	Rectangularity
2.2-2.5	51.8-65.6	13.7-15.6	0.2-0.3

Arctozenus risso (Bonaparte, 1840) Family PARALEPIDIDAE

Shape: anvil-shaped or trapezoid, dorsal region very short. *Sulcus acusticus*: heterosulcoid, ostio-caudal, supramedian. *Ostium*: oval, poorly defined, shorter than the cauda. *Cauda*: poorly defined, oval, straight. *Anterior region*: round; rostrum long, broad, round, flexed to the ventral region; antirostrum short, broad, round; excisura wide with a wide, shallow notch. *Posterior region*: round to oblique; postrostrum long, broad, flattened; postantirostrum very small, round; excisura caudalis wide, with a wide, shallow notch.

OL/TL	OH/OL	Circularity	Rectangularity
2.0	44.6	19.4	0.4

Sudis hyalina Rafinesque, 1810 Family PARALEPIDIDAE

Shape: irregular, with a conspicuous, pointed, triangular projection in the ventral region. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: tubular, longer than the cauda. *Cauda*: tubular, concave, ending close to the posterior margin. *Anterior region*: peaked; rostrum short, broad, pointed, noticeably flexed to the dorsal region; antirostrum absent or poorly defined; excisura wide without a notch. *Posterior region*: oblique, irregular, noticeably flexed to the dorsal region.

OL/CL	OH/OL	Circularity	Rectangularity
9.6	68.5	17.4	0.2

Order MYCTOPHIFORMES

Benthosema glaciale (Reinhardt, 1837) Family MYCTOPHIDAE

Shape: discoidal, wider than long with ventral margin irregular with an acute prominence. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: tubular, straight, ending close to the posterior margin. *Anterior region*: double-peaked; rostrum short, broad, round; antirostrum short, broad, round, slightly smaller than the rostrum; excisura moderately narrow with a shallow notch. *Posterior region*: round.

OL/TL	OH/OL	Circularity	Rectangularity
2.5	130.0	15.9	-0.1

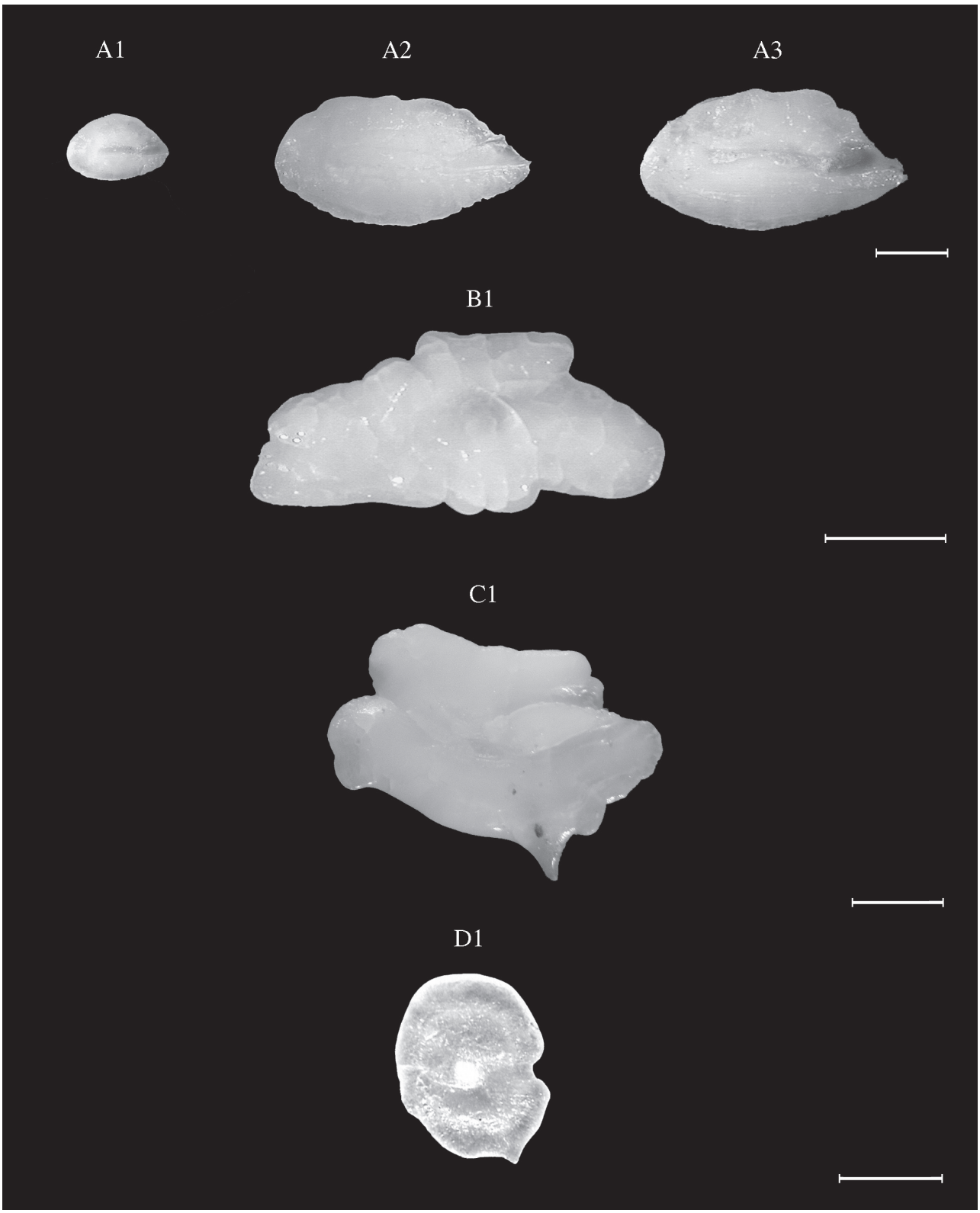

FIG. 21. – *Bathypterois mediterraneus* (WM). TL: A1, 6.0 cm; A2, 14.0 cm; A3, 17.0 cm
Arctozenus risso (WM). TL: B1, 17.0 cm.
Sudis hyalina (CEA). CL: C1, 3.7 cm.
Benthosema glaciale (WM). TL: D1, 6.0 cm.
Scale bar = 1 mm.

Bolinichthys indicus (Nafpaktitis and Nafpaktitis, 1969) Family MYCTOPHIDAE

Shape: discoidal. *Sulcus acusticus*: pseudo-archaesulcoid, ostial, supramedian. *Ostium*: funnel-like, longer than the cauda. *Cauda*: round-oval, ending far from the posterior margin. *Anterior region*: round; rostrum short, broad, round; antirostrum poorly defined; excisura moderately wide without a notch. *Posterior region*: round.

OL/TL	OH/OL	Circularity	Rectangularity
4.0	77.5	14.1	0.1

Ceratoscopelus maderensis (Lowe, 1839) Family MYCTOPHIDAE

Shape: elliptic, with dorsal margin sinuate. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, longer than the cauda. *Cauda*: round-oval, ending far from the posterior margin. *Anterior region*: peaked; rostrum long, broad, peaked; antirostrum absent; excisura wide without a notch. *Posterior region*: round.

OL/TL	OH/OL	Circularity	Rectangularity
3.6-4.2	58.2-62.9	17.1-18.2	0.2-0.3

Gonichthys cocco (Cocco, 1829) Family MYCTOPHIDAE

Shape: discoidal-pentagonal. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, longer than the cauda. *Cauda*: round-oval, ending close to the posterior margin. *Anterior region*: round; rostrum and antirostrum poorly defined, small, broad, round; excisura wide without a notch. *Posterior region*: angled.

OL/TL	OH/OL	Circularity	Rectangularity
2.5	84.7	14.1	0.1

Lampanyctus crocodilus (Risso, 1810) Family MYCTOPHIDAE

Shape: discoidal. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, longer than the cauda. *Cauda*: tubular, very short, straight, ending close to the posterior margin. *Anterior region*: double-peaked; rostrum small, broad, round or peaked; antirostrum small, broad (shorter than the rostrum), round or peaked; excisura wide with a deep, acute notch. *Posterior region*: round to irregular.

OL/TL	OH/OL	Circularity	Rectangularity
2.2-2.4	85.1-93.2	16.4-17.7	0.0-0.1

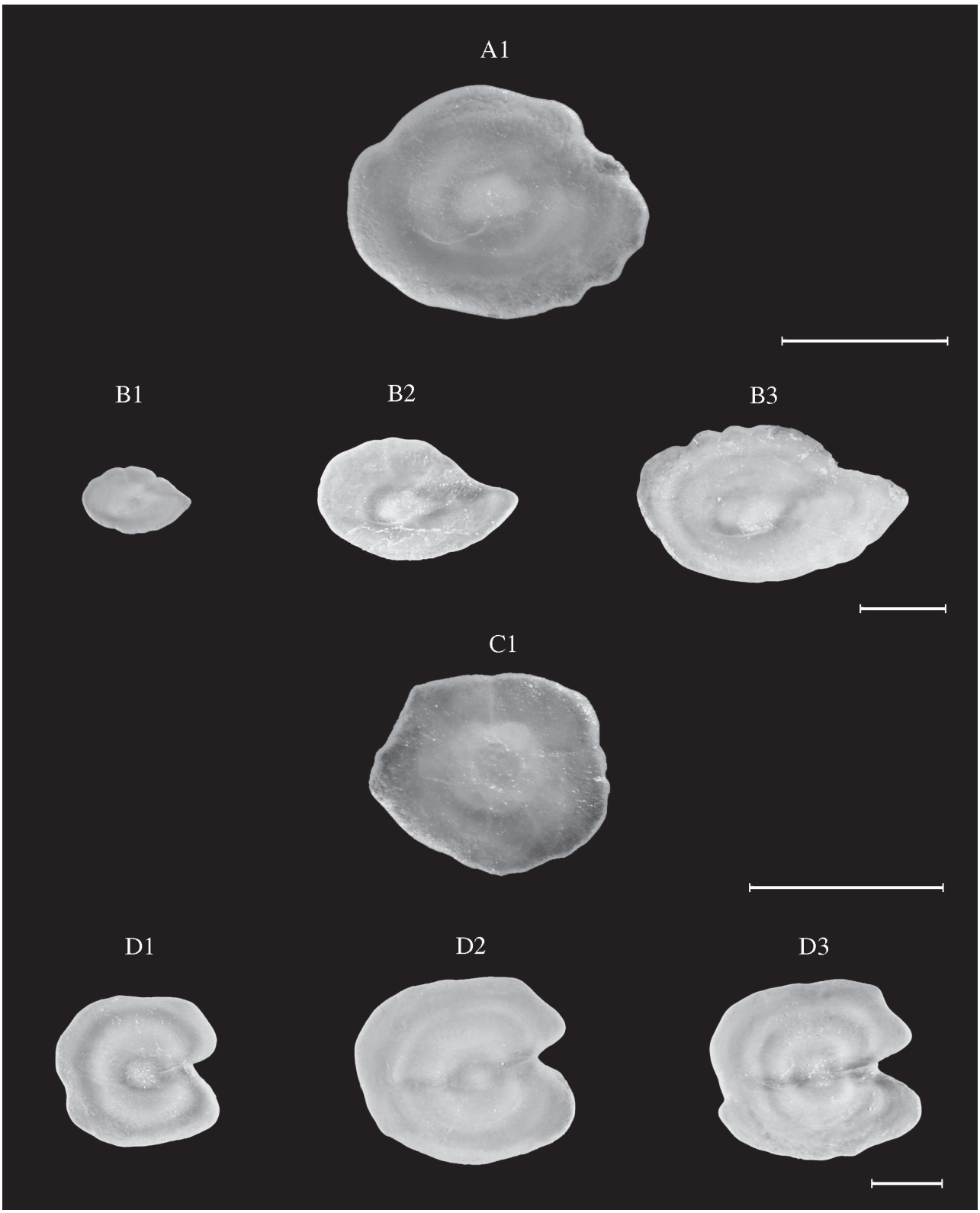

FIG. 22. – *Bolinichthys indicus* (NEA). TL: A1, 4.5 cm.
Ceratoscopelus maderensis. TL: B1, 3.6 cm (NEA); B2, 5.5 cm (WM); B3, 7.5 cm (WM).
Gonichthys cocco (NEA). TL: C1, 5.0 cm.
Lampanyctus crocodilus (WM). TL: D1 11.0 cm; D2, 13.6 cm; D3, 14.5 cm.
Scale bar = 1 mm.

Myctophum punctatum Rafinesque, 1810 Family MYCTOPHIDAE

Shape: discoidal, with dorsal margin sinuate. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: tubular, longer than the cauda. *Cauda*: tubular, very short, straight, ending far from the posterior margin. *Anterior region*: double-peaked; rostrum small, broad, peaked; antirostrum small, narrow, peaked; excisura wide with a deep, acute notch. *Posterior region*: round.

OL/TL	OH/OL	Circularity	Rectangularity
4.1-4.3	78.2-87.4	13.7-15.9	0.1

Notoscopelus bolini Nafpaktitis, 1975 Family MYCTOPHIDAE

Shape: elliptic, with margins crenate. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: tubular, much longer than the cauda. *Cauda*: tubular, very short, straight, ending far from the posterior margin. *Anterior region*: peaked; rostrum small, broad, peaked; antirostrum small, narrow, peaked; excisura wide with a shallow, acute notch. *Posterior region*: round.

OL/TL	OH/OL	Circularity	Rectangularity
3.9	40.0	20.4	0.4

Notoscopelus elongatus (Costa, 1844) Family MYCTOPHIDAE

Shape: elliptic, with serrate ventral margin in the larger otoliths. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: tubular, longer than the cauda. *Cauda*: tubular, very short, straight, ascending in the larger otoliths, ending far from the posterior margin. *Anterior region*: peaked; rostrum small, broad, peaked; antirostrum poorly defined or small, narrow, peaked; excisura wide with a shallow, acute notch. *Posterior region*: round.

OL/TL	OH/OL	Circularity	Rectangularity
4.5-4.9	56.8-61.7	17.0-19.9	0.2-0.3

Symbolophorus veranyi (Moreau, 1888) Family MYCTOPHIDAE

Shape: discoidal to oval, with margins serrate to entire. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: tubular, as long as the cauda. *Cauda*: tubular, straight, ending far from the posterior margin. *Anterior region*: slightly peaked; rostrum small, broad, peaked; antirostrum poorly defined or small, narrow, peaked; excisura wide with or without a shallow, acute notch. *Posterior region*: round.

OL/TL	OH/OL	Circularity	Rectangularity
4.4-4.7	58.5-70.5	15.7-17.0	0.2-0.3

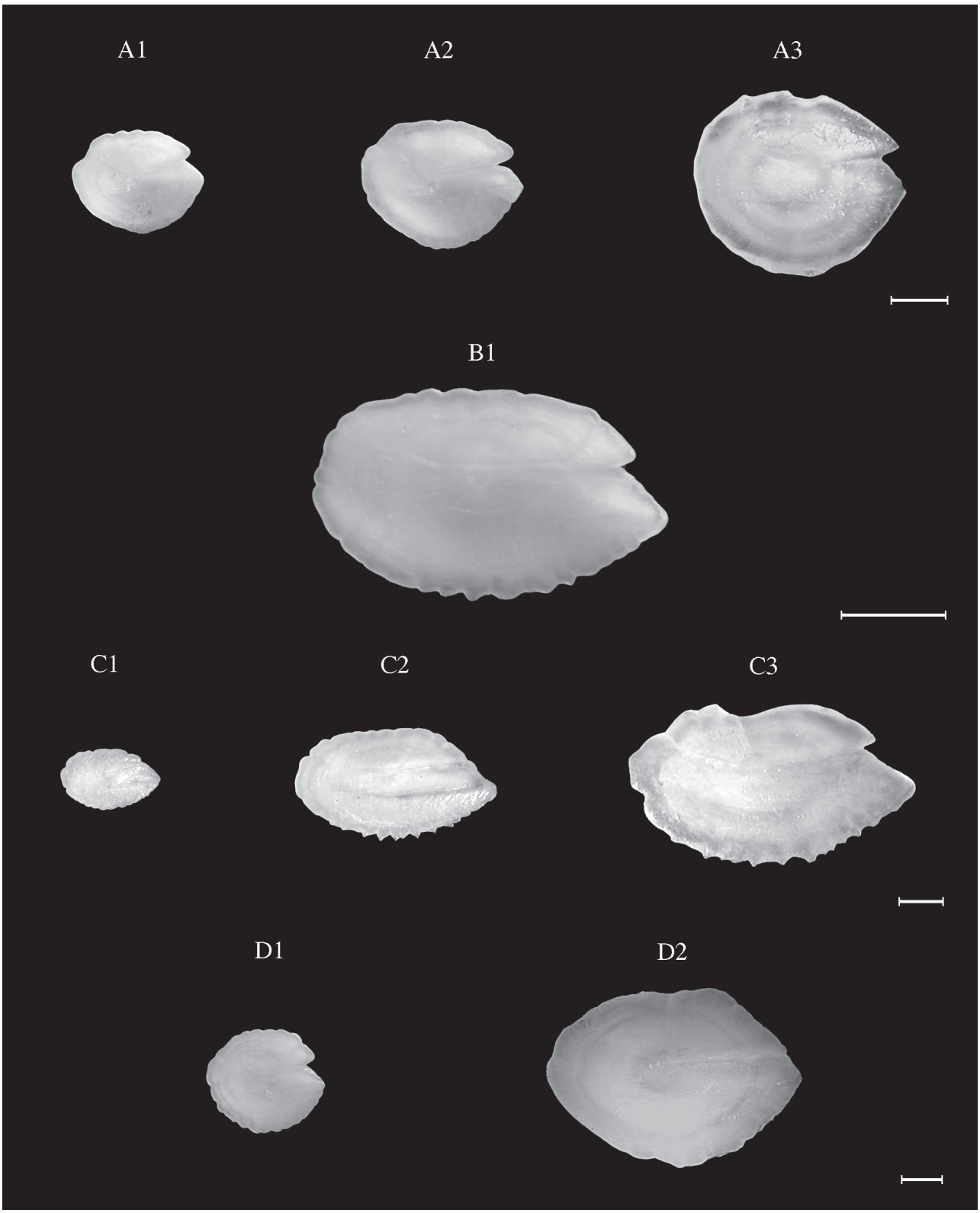

FIG. 23. – *Myctophum punctatum*. TL: A1, 5.5 cm (NEA); A2, 7.1 cm (NEA); A3, 9.0 cm (WM).
Notoscopelus bolini (NEA). TL: B1, 8.6 cm.
Notoscopelus elongatus (WM). TL: C1, 5.0 cm; C2, 9.5 cm; C3, 13.0 cm.
Symbolophorus veranyi. TL: D1, 6.2 cm (NEA); D2, 13.0 cm (WM).
Scale bar = 1 mm.

Order LAMPRIFORMES

Trachipterus trachypterus (Gmelin, 1789) Family TRACHIPTERIDAE

Shape: discoidal, with marked lobes. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: tubular, straight, wider than the ostium, crista superior slightly flexed to the dorsal area, ending close to the posterior margin. *Anterior region*: round and irregular; rostrum and antirostrum, short, broad, round; excisura wide without a notch. *Posterior region*: round to irregular.

OL/TL	OH/OL	Circularity	Rectangularity
0.2	93.0	14.7	0.0

Order POLYMIXIIFORMES

Polymixia nobilis Lowe, 1838 Family POLYMIXIIDAE

Shape: approximately pentagonal. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: tubular, curved, markedly curled from the middle region, ending close to the postero-ventral margin. *Anterior region*: angled; rostrum short, broad, round to slightly flattened; antirostrum poorly defined or narrow, very short, peaked; excisura wide with a deep, acute or shallow notch. *Posterior region*: angled to irregular.

OL/TL	OH/OL	Circularity	Rectangularity
3.1-3.8	68.7-72.6	15.3-16.7	0.2

Order GADIFORMES

Caelorinchus caelorhincus (Risso, 1810) Family MACROURIDAE

Shape: elliptic-irregular to trapezoidal, with the ventral region more developed than the dorsal, dorsal and posterior margins lobed, smoother in the larger otoliths. *Sulcus acusticus*: homosulcoid, mesial or pseudo-ostiaocaudal, median. *Ostium*: oval, slightly shorter than the cauda. *Cauda*: tubular, straight, longer than the ostium with a similar width, separated from the ostium by a solid bridge collum. *Anterior region*: angled. *Posterior region*: pointed to lanceolated.

OL/PL	OH/OL	Circularity	Rectangularity
13.3-27.9	50.1-68.9	15.5-17.1	0.2-0.3

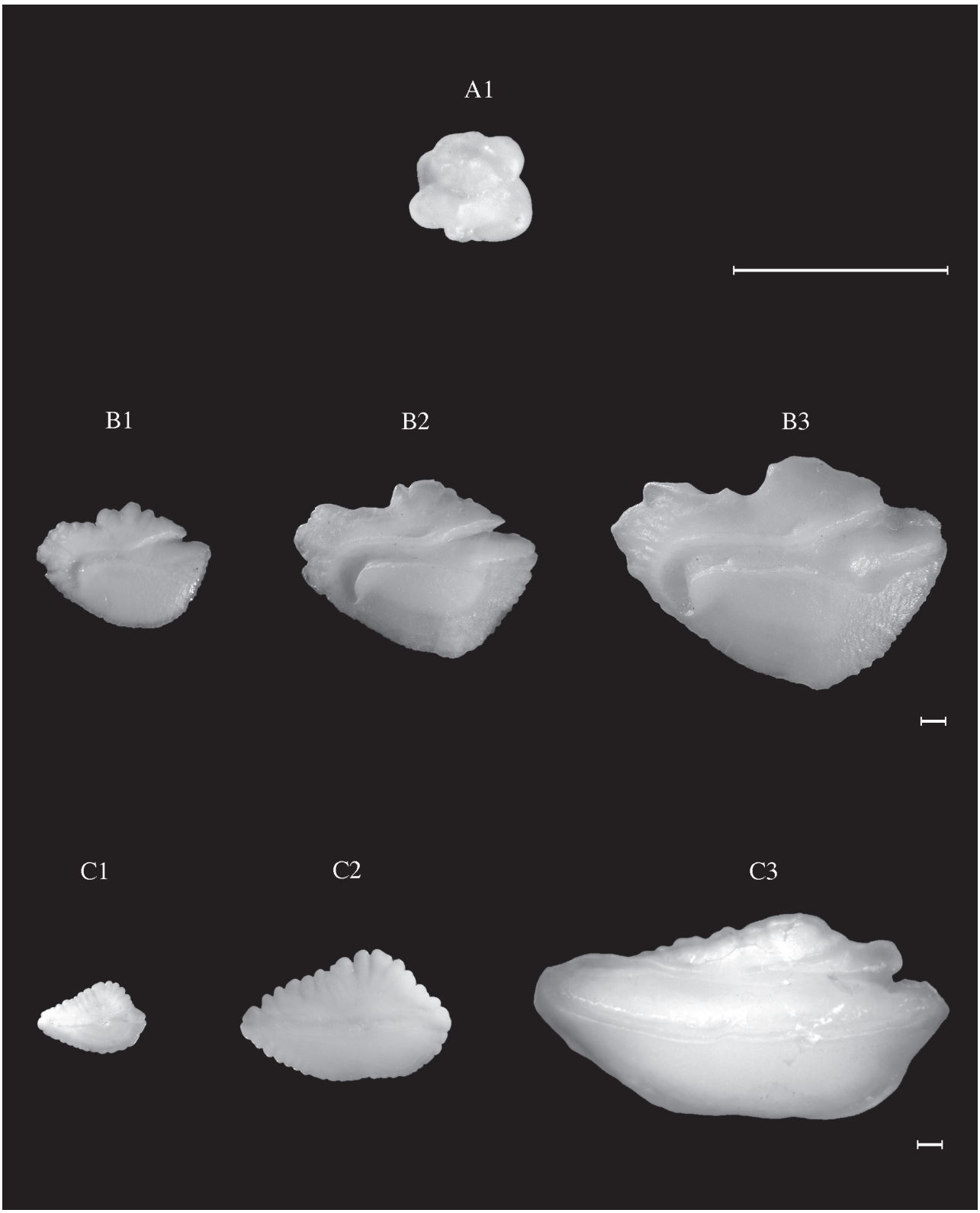

FIG. 24. – *Trachipterus trachipterus* (WM). TL: A1, 30.0 cm.
Polymixia nobilis (CEA). TL: B1, 17.5 cm; B2, 28.2 cm; B3, 41.7 cm.
Caelorinchus caelorhincus. PL: C1, 1.5 cm (WM); C2, 6.1 cm (NEA); C3, 11.5 cm (WM).
Scale bar = 1 mm.

Caelorinchus mediterraneus Iwamoto and Ungaro, 2002 Family MACROURIDAE

Shape: oval to trapezoidal with the ventral region more developed. *Sulcus acusticus*: homosulcoid, mesial to ostio-caudal, median. *Ostium*: elliptic, as long as the cauda. *Cauda*: elliptic, straight, similar to the ostium in width, separated from it by a solid bridge collum. *Anterior region*: oblique to angled; rostrum and antirostrum absent or broad, short, round, antirostrum shorter than the rostrum: excisura narrow with a deep, acute notch. *Posterior region*: slightly pointed to round without defined features or postrostrum broad, short, round; postantirostrum absent; excisura caudalis narrow with a shallow notch.

OL/PL	OH/OL	Circularity	Rectangularity
13.3-15.8	54.1-60.0	14.8-16.3	0.3

Coryphaenoides guentheri (Vaillant, 1888) Family MACROURIDAE

Shape: roughly oval. *Sulcus acusticus*: homosulcoid, mesial to ostio-caudal, median. *Ostium*: elliptic, sometimes open in the anterior margin. *Cauda*: elliptic, straight, shorter than the ostium, sometimes open towards the posterior region. *Anterior region*: round to double-peaked; rostrum and antirostrum short, broad, round or blunt, of similar size; *excisura* narrow with a shallow notch. *Posterior region*: round to round-oblique; without defined features or postrostrum broad, short and blunt; postantirostrum absent; excisura caudalis narrow with a wide, shallow notch.

OL/PL	OH/OL	Circularity	Rectangularity
9.5-9.7	60.2-68.6	14.1-16.7	0.2-0.3

Coryphaenoides mediterraneus (Giglioli, 1893) Family MACROURIDAE

Shape: roughly elliptic. *Sulcus acusticus*: homosulcoid, mesial, median. *Ostium*: elliptic, shorter than the cauda, ascending to the dorsal area. *Cauda*: elliptic, straight, as wide as the ostium, descending to the ventral area, separated from the ostium by a solid bridge collum. *Anterior region*: round. *Posterior region*: slightly pointed.

OL/PL	OH/OL	Circularity	Rectangularity
7.3-13.5	51.8-59.5	14.5-15.4	0.3

Coryphaenoides rudis Günther, 1878 Family MACROURIDAE

Shape: kidney-shaped. *Sulcus acusticus*: homosulcoid, para-ostial, supramedian. *Ostium and cauda*: rectangular, very broad, slightly concave. *Anterior region*: round; excisura, very narrow without a notch. *Posterior region*: round.

OL/CL	OH/OL	Circularity	Rectangularity
5.4-5.6	59.1-59.8	14.9-16.2	0.3

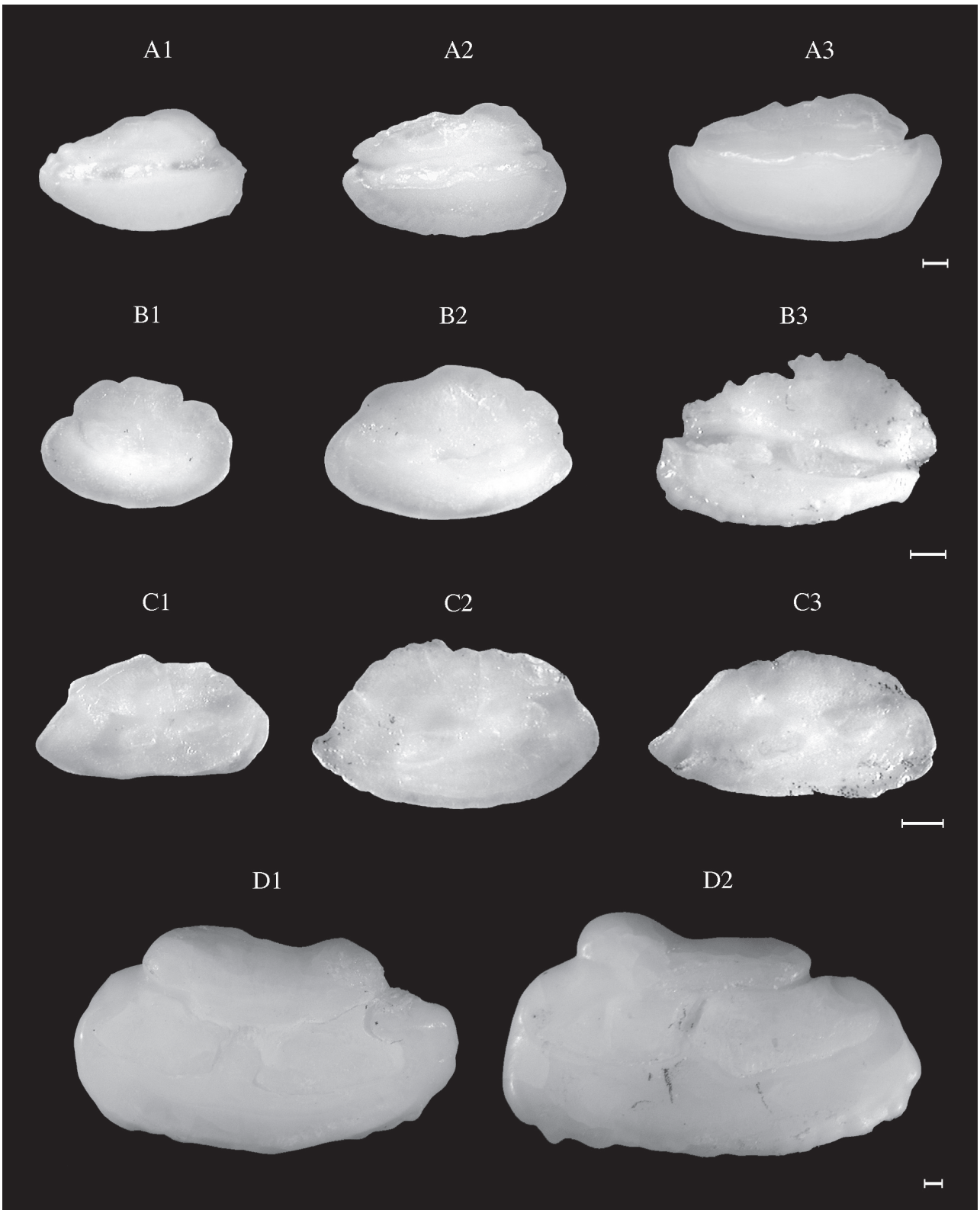

FIG. 25. – *Caelorinchus mediterraneus* (WM). PL: A1, 5.0 cm; A2, 6.5 cm; A3, 7.5 cm.
Coryphaenoides guentheri (WM). PL: B1, 5.5 cm; B2, 7.0 cm; B3, 8.0 cm.
Coryphaenoides mediterraneus (WM). PL: C1, 5.0 cm; C2, 6.0 cm; C3, 7.5 cm.
Coryphaenoides rudis (CEA). CL: D1, 23.0; D2, 23.5 cm.
Scale bar = 1 mm.

Hymenocephalus italicus Giglioli, 1884 Family MACROURIDAE

Shape: elliptic, with a highly lobed prominence in the anterior dorsal margin. *Sulcus acusticus*: archaesulcoid, mesial, median. *Ostium and cauda*: tubular, broad, straight without constriction between them. *Anterior region*: irregular to double-peaked. *Posterior region*: irregular to double-peaked, more prominent than the anterior region.

OL/PL	OH/OL	Circularity	Rectangularity
12.0-16.3	90.2-109.8	15.4-19.4	0.0-0.1

Malacocephalus laevis (Lowe, 1843) Family MACROURIDAE

Shape: elliptic, margins lobed to sinuate. *Sulcus acusticus*: homosulcoid, mesial. *Ostium and cauda*: broad and similar in size, straight, separated by a solid bridge collum. *Anterior region*: angled-irregular to round. *Posterior region*: round to oblique.

OL/PL	OH/OL	Circularity	Rectangularity
11.6-16.5	50.4-61.4	15.5-16.7	0.2-0.3

Nezumia aequalis (Günther, 1878) Family MACROURIDAE

Shape: approximately oval, margins lobed in the smallest otoliths. *Sulcus acusticus*: homosulcoid, mesial, median. *Ostium*: elliptic, similar to the cauda in size. *Cauda*: elliptic, ending far from the posterior margin. *Anterior region*: peaked to angled. *Posterior region*: round to asymmetric angled-round.

OL/PL	OH/OL	Circularity	Rectangularity
14.8-17.9	59.3-71.7	14.6-16.5	0.2-0.3

Nezumia sclerorhynchus (Valenciennes, 1838) Family MACROURIDAE

Shape: approximately oval. *Sulcus acusticus*: homosulcoid, mesial to pseudo-ostial in the largest otoliths, median *Ostium*: elliptic, similar to the cauda in size. *Cauda*: straight, ending far from the posterior margin. *Anterior region*: angled, without defined features or rostrum and antirostrum short, broad, round; excisura absent or wide without a notch. *Posterior region*: peaked.

OL/PL	OH/OL	Circularity	Rectangularity
14.1-17.3	54.7-61.1	14.4-15.5	0.2-0.3

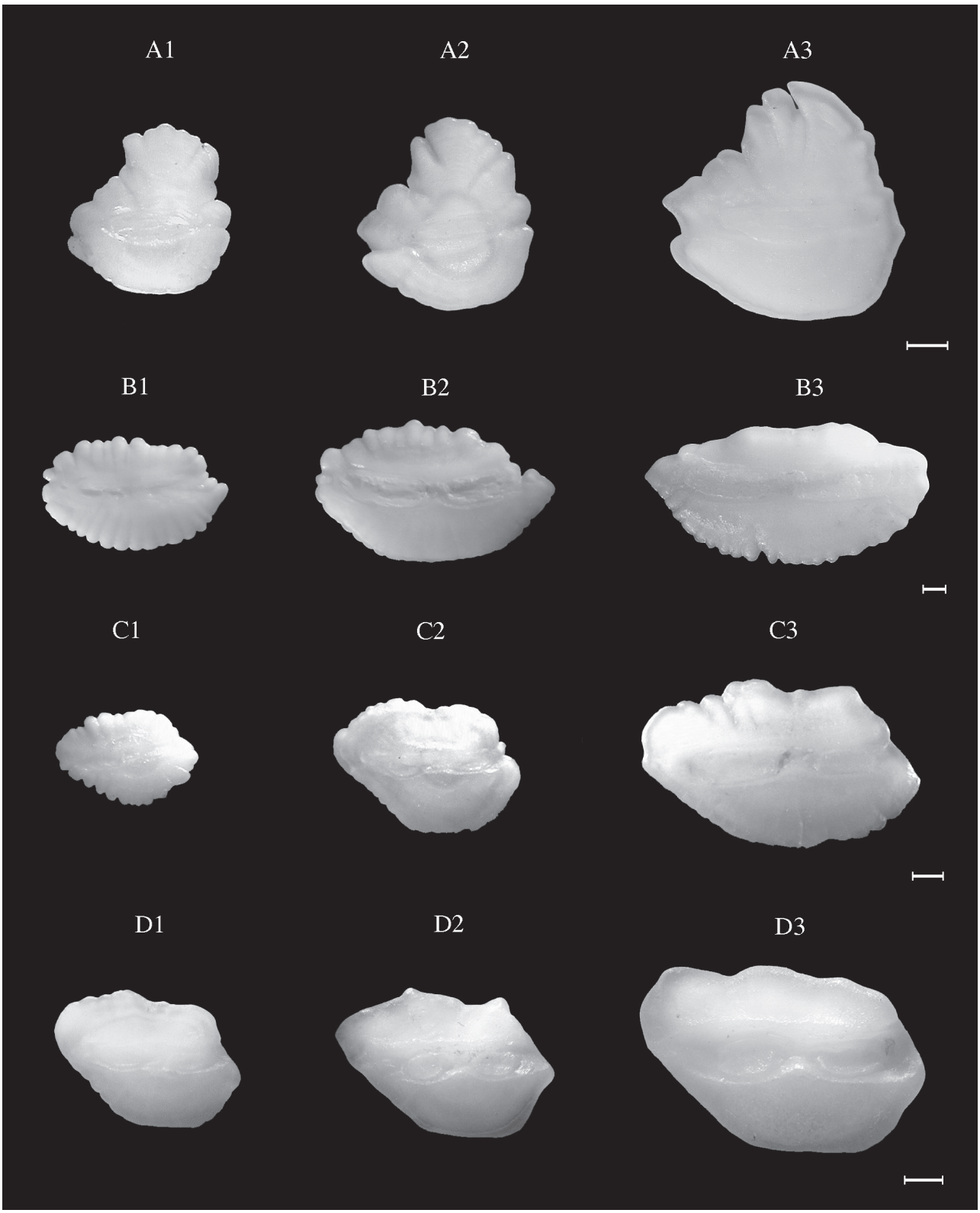

FIG. 26. – *Hymenocephalus italicus*. PL: A1, 2.5 cm (WM); A2, 3.4 cm (NEA); A3, 4.9 cm (NEA).
Malacocephalus laevis. PL: B1, 4.6 cm (NEA); B2, 6.9 cm (NEA); B3, 10.1 cm (CEA).
Nezumia aequalis (WM). PL: C1, 2.5 cm; C2, 4.0 cm; C3, 5.5 cm.
Nezumia sclerorhynchus (NEA). PL: D1, 2.0 cm; D2, 4.1 cm (WM); D3, 6.3 cm (NEA).
Scale bar = 1 mm.

Trachyrincus scabrus (Rafinesque, 1810) Family MACROURIDAE

Shape: elliptic, with a conspicuous lobe-shaped anterior dorsal prominence. *Sulcus acusticus*: heterosculcoid, pseudo-ostiocaudal or mesial, median. *Ostium*: oval, shorter than the cauda. *Cauda*: tubular, straight, separated from the ostium by a slight ventral constriction. *Anterior region*: angled. *Posterior region*: round to slightly peaked.

OL/PL	OH/OL	Circularity	Rectangularity
9.3-10.0	87.6-91.2	15.1-18.1	0.1

Antimora rostrata (Günther, 1878) Family MORIDAE

Shape: sagitiform. *Sulcus acusticus*: heterosucloid, caudal, median. *Ostium*: elliptic, shorter than the cauda, ending very close to the anterior margin. *Cauda*: funnel-like, slightly convex. *Anterior region*: slightly peaked. *Posterior region*: prominently peaked; postrostrum long, narrow, sharply pointed; postantirostrum short, narrow, pointed; excisura caudalis wide with a deep, acute notch.

OL/TL	OH/OL	Circularity	Rectangularity
-	39.2	22.1	0.4

Gadella maraldi (Risso, 1810) Family MORIDAE

Shape: sagitiform. *Sulcus acusticus*: heterosucloid, caudal, median. *Ostium*: elliptic, shorter than the cauda, ending very close to the anterior margin. *Cauda*: funnel-like, slightly convex. *Anterior region*: slightly peaked, curved to the dorsal region. *Posterior region*: prominently peaked; postrostrum long, narrow, sharply pointed; postantirostrum short, narrow, sharply pointed; excisura caudalis wide with a deep, acute notch.

OL/TL	OH/OL	Circularity	Rectangularity
4.3-5.6	36.3-38.6	24.8-27.0	0.4-0.5

Laemonema yarrellii (Lowe, 1838) Family MORIDAE

Shape: sagitiform. *Sulcus acusticus*: heterosucloid, caudal, median. *Ostium*: elliptic, shorter than the cauda, ending very close to the anterior margin. *Cauda*: funnel-like, slightly convex. *Anterior region*: round. *Posterior region*: prominently peaked; postrostrum long, narrow, sharply pointed with the tip stepped; postantirostrum short, narrow, sharply pointed; excisura caudalis wide with a deep, acute notch.

OL/TL	OH/OL	Circularity	Rectangularity
5.3-5.4	33.2-38.8	23.1-24.2	0.4-0.5

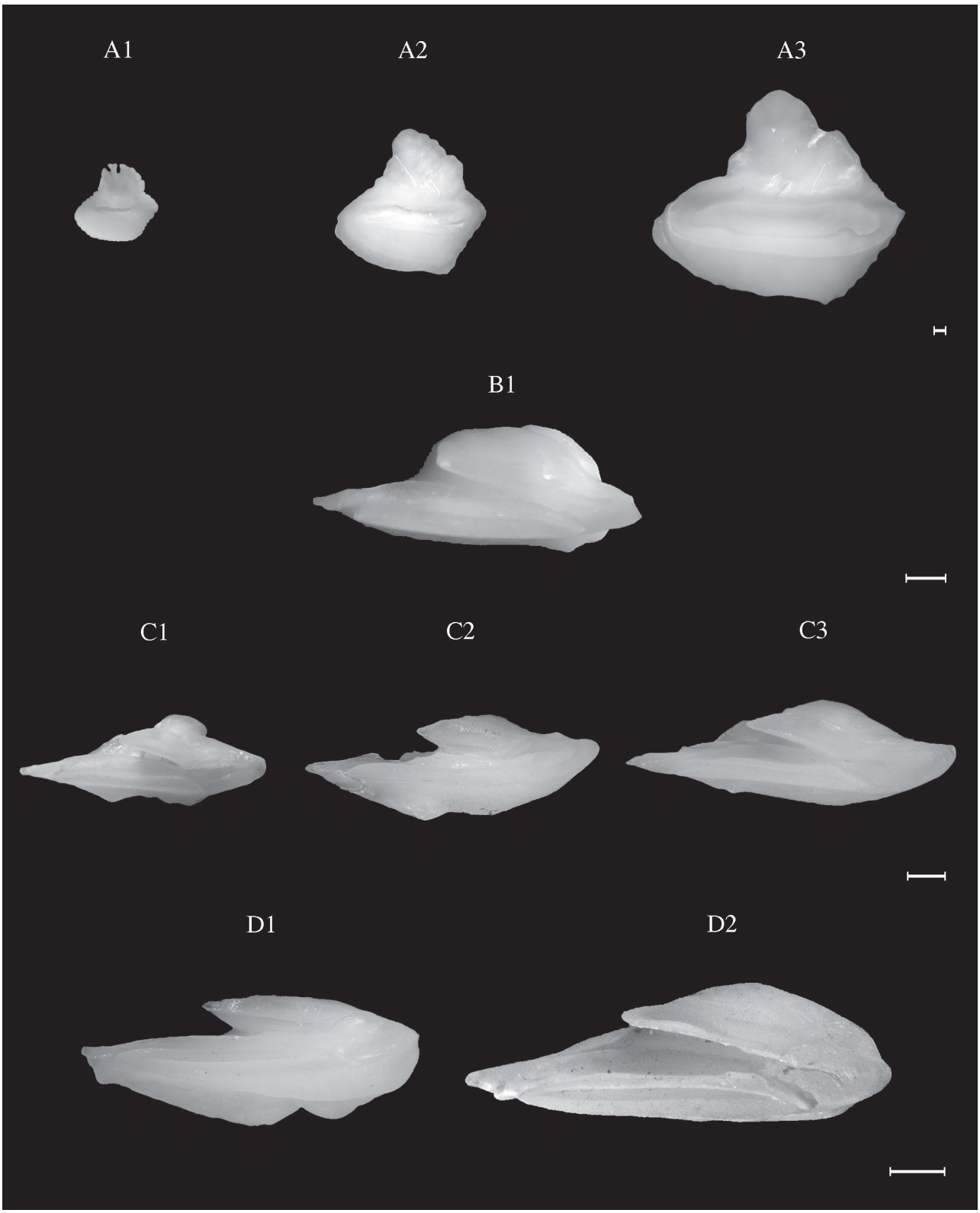

FIG. 27. – *Trachyrincus scabrus*. PL: A1, 6.2 cm (NEA); A2, 11.5 cm (WM); A3, 20.0 cm (WM)
Antimora rostrata (CEA). TL: B1, no data available.
Gadella maraldi. TL: C1, 9.0 cm (WM); C2, 14.6 cm (CEA); C3, 17.8 cm (NEA).
Laemonema yarrellii (CEA). TL: D1, 11.6 cm; D2, 14.1 cm.
Scale bar = 1 mm.

Lepidion lepidion (Risso, 1810) Family MORIDAE

Shape: rectangular to oblong. *Sulcus acusticus*: heterosucloid, caudal, median. *Ostium*: elliptic, similar to the cauda in size, ending close to the anterior margin. *Cauda*: tubular, wider posteriorly, slightly convex. *Anterior region*: round. *Posterior region*: blunt to peaked; postrostrum short to long, narrow, blunt to sharply pointed; postantirostrum short, narrow, blunt to sharply pointed; excisura caudalis wide with a shallow notch.

OL/TL	OH/OL	Circularity	Rectangularity
3.8-6.9	39.8-42.0	18.5-20.0	0.4

Mora moro (Risso, 1810) Family MORIDAE

Shape: pyriform asymetrical, with a large anterior dorsal prominence that increases with growth. *Sulcus acusticus*: heterosucloid, caudal, inframedian. *Ostium*: approximately rectangular, very broad, as long as the cauda. *Cauda*: tubular, wider posteriorly, slightly convex. *Anterior region*: round to oblique. *Posterior region*: double-peaked; postantirostrum and postrostrum narrow, very long, pointed, similar in size; excisura caudalis wide with an acute notch deeper in the largest otoliths.

OL/TL	OH/OL	Circularity	Rectangularity
3.2-7.4	52.9-61.7	22.8-27.3	0.2-0.3

Physiculus dalwigki Kaup, 1858 Family MORIDAE

Shape: sagitiform. *Sulcus acusticus*: heterosucloid, caudal, median. *Ostium*: elliptic, shorter than the cauda, ending close to the anterior margin. *Cauda*: funnel-like, slightly convex. *Anterior region*: slightly pointed. *Posterior region*: peaked; postrostrum narrow, very prolonged, round or slightly pointed; postantirostrum short, narrow, pointed; excisura caudalis wide with a deep, acute notch.

OL/TL	OH/OL	Circularity	Rectangularity
4.7-5.3	30.4-31.8	24.3-25.2	0.5

Merluccius merluccius (Linnaeus, 1758) Family MERLUCCIIDAE

Shape: lanceolated, dorsal and posterior margins lobed to dentate. *Sulcus acusticus*: homosulcoid, mesial although may appear ostio-caudal, supramedian, slightly concave dorsally. *Ostium*: elliptic, broad, shorter than the cauda, ending close to the anterior margin. *Cauda*: elliptic, broad, separated from the ostium by a wall-like or solid bridge collum that ends close to the postero-dorsal margin. *Anterior region*: round to oblique. *Posterior region*: peaked to lanceolated.

OL/TL	OH/OL	Circularity	Rectangularity
3.8-4.6	30.2-39.3	20.0-28.2	0.4-0.5

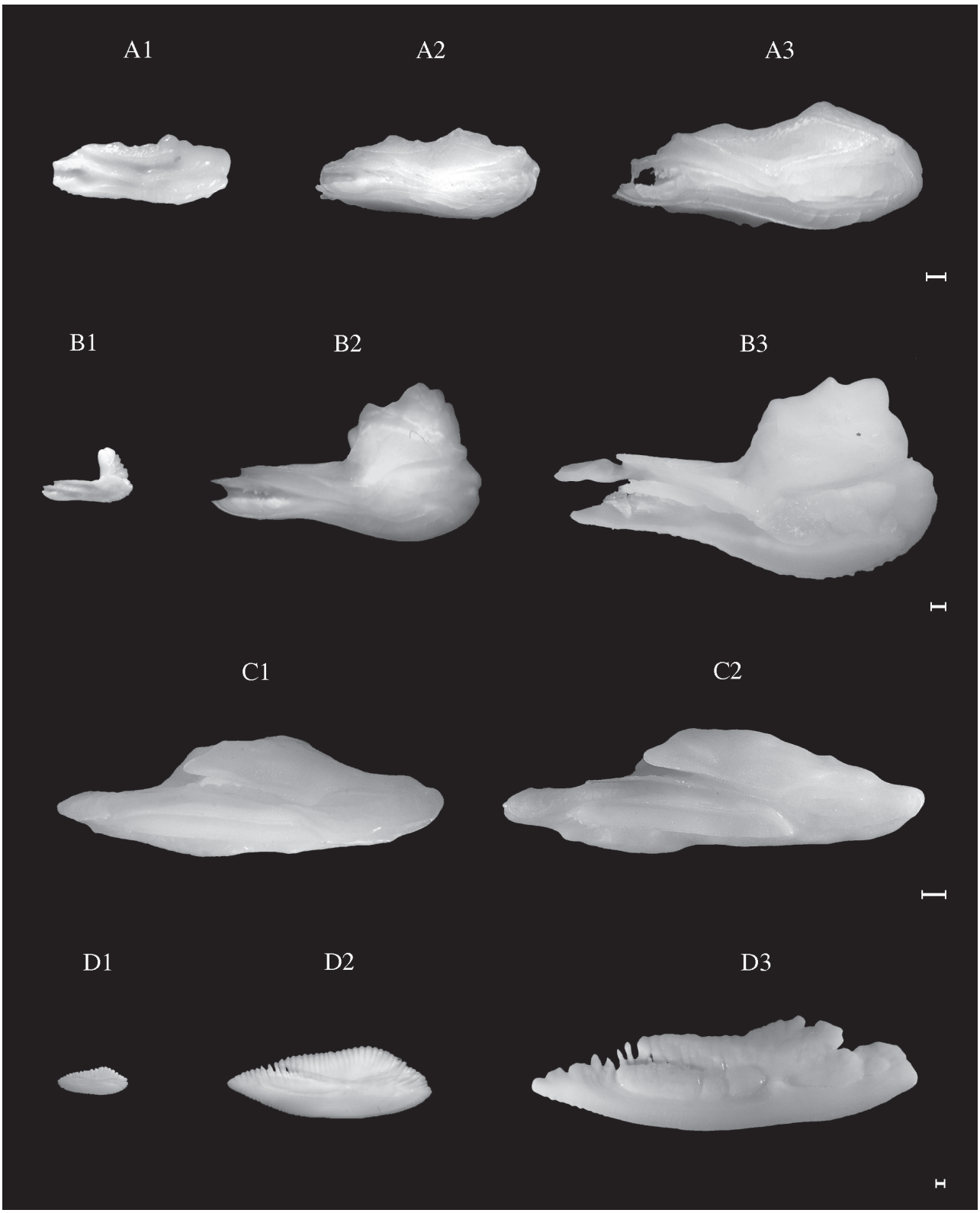

FIG. 28. – *Lepidion lepidion* (WM). TL: A1, 13.0 cm; A2, 20.0 cm; A3, 29.8 cm.
Mora moro. TL: B1, 7.5 cm (WM); B2, 43.0 cm (WM); B3, 73.0 cm (CEA).
Physiculus dalwigki (CEA). TL: C1, 22.5 cm; C2, 27.5 cm.
Merluccius merluccius. TL: D1, 15.4 cm (NEA); D2, 53.0 cm (WM); D3, 98.8 cm (CEA).
Scale bar = 1 mm.

Merluccius polli Cadenat, 1950 Family MERLUCCIIDAE

Shape: lancelolated to elliptic, slightly kidney-shaped in the larger otoliths, dorsal margin lobed in the smaller otoliths. *Sulcus acusticus*: homosulcoid, clearly mesial, median to supramedian, slightly concave dorsally. *Ostium*: elliptic, shorter than the cauda, ending far from the anterior margin. *Cauda*: elliptic, broad, separated from the ostium by a wall-like collum that ends far from the posterior margin. *Anterior region*: round to angled, with a double-peaked tip in the larger otoliths. *Posterior region*: round to angled, sometimes with a double-peaked tip in the larger otoliths.

OL/TL	OH/OL	Circularity	Rectangularity
3.5-5.0	34.6-39.4	18.2-19.3	0.4-0.5

Merluccius senegalensis Cadenat, 1950 Family MERLUCCIIDAE

Shape: lancelolated, dorso-anterior margin more developed and lobed to sinuate. *Sulcus acusticus*: homosulcoid, clearly mesial, supramedian, slightly concave dorsally. *Ostium*: elliptic, shorter than the cauda, ending far from the anterior margin. *Cauda*: elliptic, broad, separated from the ostium by a wall-like collum, ending far from the posterior margin. *Anterior region*: round to oblique. *Posterior region*: peaked.

OL/TL	OH/OL	Circularity	Rectangularity
2.8-4.3	38.1-44.2	17.8-19.1	0.4-0.5

Ciliata mustela (Linnaeus, 1758) Family PHYCIDAE

Shape: elliptic to trapezoidal. *Sulcus acusticus*: homosulcoid, ostiocaudal, median. *Ostium and cauda*: funnel-like, separated by a raised tubercle collum (shaped like an eight), slightly sinuous (concave ostium and convex cauda), similar in size, inferior crista straight at the rostrum and postrostrum tips. *Anterior region*: peaked to oblique, rostrum short, broad, peaked; antirostrum absent or very short, broad, round; excisura very wide with or without a shallow notch. *Posterior region*: round to round-oblique, postrostrum very short, broad, round; postantirostrum absent or very short, broad, round; excisura caudalis wide with or without a shallow notch.

OL/TL	OH/OL	Circularity	Rectangularity
1.5-1.9	23.7-35.3	20.5-27.6	0.5-0.6

Gaidropsarus biscayensis (Collet, 1890) Family PHYCIDAE

Shape: elliptic. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, as long as the cauda. *Cauda*: elliptic, straight, ending close to the posterior margin. *Anterior region*: slightly peaked; rostrum short, broad, peaked; antirostrum absent; excisura very wide without a notch. *Posterior region*: round to oblique.

OL/TL	OH/OL	Circularity	Rectangularity
2.4-2.8	37.8-38.6	18.7-19.3	0.4-0.5

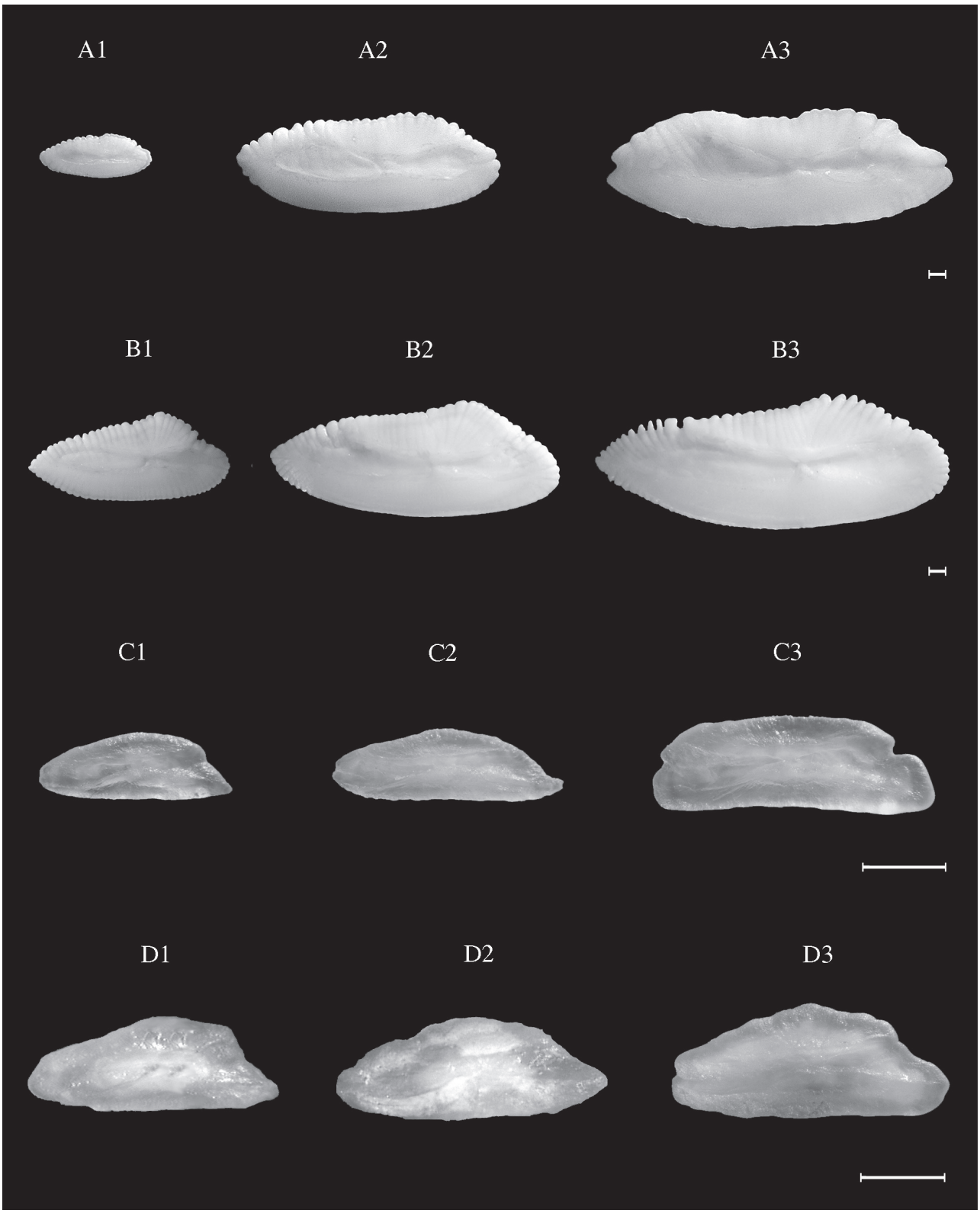

FIG. 29. – *Merluccius polli* (CEA). TL: A1, 14.1 cm; A2, 29.4 cm; A3, 55.2 cm.
Merluccius senegalensis (CEA). TL: B1, 25.6 cm; B2, 40.2 cm; B3, 56.9 cm.
Ciliata mustela (NEA). TL: C1, 11.8 cm; C2, 14.5 cm; C3, 22.2 cm.
Gaidropsarus biscayensis. TL: D1, 10.5 cm (WM); D2, 13.0 cm (WM); D3, 16.4 cm (NEA).
Scale bar = 1 mm.

Gaidropsarus mediterraneus (Linnaeus, 1758) Family PHYCIDAE

Shape: elliptic. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, similar to the cauda in size. *Cauda*: elliptic, straight, ending close to the posterior margin, separated from the ostium by a raised tubercle collum, *Anterior region*: oblique to irregular; rostrum short, broad, peaked; antirostrum absent; excisura very wide without a notch. *Posterior region*: round.

OL/TL	OH/OL	Circularity	Rectangularity
1.8	41.5	18.8	0.4

Phycis blennoides (Brünnich, 1768) Family PHYCIDAE

Shape: lanceolated to oblong, anterior region wider, margins crenate in the smaller otoliths. *Sulcus acusticus*: archaesulcoid, pseudo-ostial although may appear ostiocaudal, median, slightly concave dorsally, long, broad, approaching both the anterior and posterior margins. *Ostium and cauda*: undifferentiated. *Anterior region*: round to oblique-angled, rostrum poorly defined; antirostrum absent; excisura very narrow without a notch. *Posterior region*: lanceolated to peaked.

OL/TL	OH/OL	Circularity	Rectangularity
3.0-6.7	35.7-37.3	19.1-20.2	0.5

Phycis phycis (Linnaeus, 1766) Family PHYCIDAE

Shape: lanceolated to oblong, anterior region wider, antero-ventral margin iregularly dentate. *Sulcus acusticus*: archaesulcoid, pseudo-ostial although may appear ostiocaudal, median, slightly concave dorsally, long, broad, approaching both the anterior and posterior margins. *Ostium and cauda*: undifferentiated. *Anterior region*: round to oblique, rostrum poorly defined; antirostrum absent; excisura narrow without a notch. *Posterior region*: peaked.

OL/TL	OH/OL	Circularity	Rectangularity
3.0-4.6	42.7-48.3	17.6-18.4	0.4-0.5

Gadiculus argenteus Guichenot, 1850 Family GADIDAE

Shape: oval, anterior region more globose than the posterior. *Sulcus acusticus*: heterosucloid, mesial although may appear pseudo-ostial, median. *Ostium*: round to oval, slightly shorter than the cauda, ending close to the anterior margin. *Cauda*: tubular, straight, ending close to the posterior margin. *Anterior region*: round to irregular. *Posterior region*: angled to round-irregular.

OL/TL	OH/OL	Circularity	Rectangularity
6.1-6.6	62.6-67.0	14.4-15.3	0.2

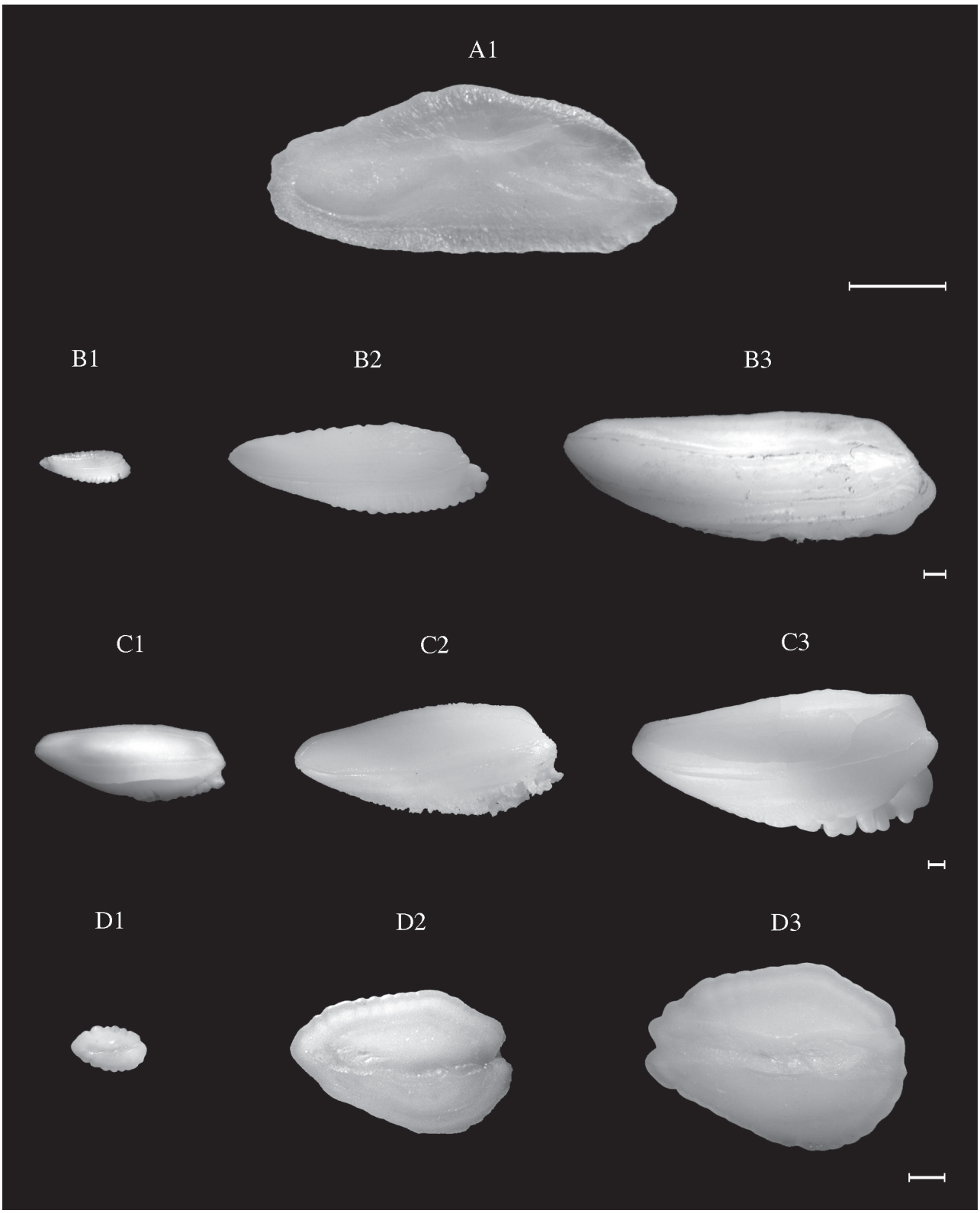

FIG. 30. – *Gaidropsarus mediterraneus* (NEA). TL: A1, 23.3 cm.
Phycis blennoides. TL: B1, 6.0 cm (WM); B2, 26.0 cm (NEA); B3, 55.0 cm (WM).
Phycis phycis. TL: C1, 21.5 cm (WM); C2, 34.5 cm (CEA); C3, 54.1 cm (NEA).
Gadiculus argenteus. TL: D1, 3.5 cm (WM); D2, 9.3 cm (WM); D3, 14.5 cm (NEA).
Scale bar = 1 mm.

Merlangius merlangus (Linnaeus, 1758) Family GADIDAE

Shape: lanceoated, anterior region more globose than the posterior, margins lobed in the smaller otoliths. *Sulcus acusticus*: heterosulcoid, pseudo-ostiocaudal, median. *Ostium*: elliptic, broad, shorter than the cauda. *Cauda*: tubular, straight, as wide as the ostium, separated from the ostium by a solid bridge-like collum. *Anterior region*: round to irregular. *Posterior region*: sharply lanceolated.

OL/TL	OH/OL	Circularity	Rectangularity
-	33.8-35.6	19.4-24.0	0.5

Micromesistius poutassou (Risso, 1827) Family GADIDAE

Shape: lanceloated to spindle-shaped, anterior region more globose than the posterior, margins lobed in the smaller otoliths. *Sulcus acusticus*: heterosulcoid, pseudo-ostiocaudal, median. *Ostium*: approximately tubular, broad, shorter than the cauda. *Cauda*: tubular, straight, as wide as the ostium, separated from the ostium by a solid bridge-like collum. *Anterior region*: round. *Posterior region*: lanceolated

OL/TL	OH/OL	Circularity	Rectangularity
4.3-5.9	33.8-35.6	19.4-24.0	0.5

Molva dypterygia (Pennant, 1784) Family GADIDAE

Shape: elliptic, margins lobed. *Sulcus acusticus*: homosulcoid, mesial, median. *Ostium*: elliptic, similar to the cauda in size, slightly convex, ending close to the anterior margin. *Cauda*: elliptic, as wide as the ostium, separated from the ostium by a wall-like collum, ending close to the posterior margin. *Anterior region*: slightly peaked. *Posterior region*: round to round-oblique.

OL/CL	OH/OL	Circularity	Rectangularity
2.0-2.2	39.4-44.1	18.3-18.8	0.4

Molva molva (Linnaeus, 1758) Family GADIDAE

Shape: approximately parallelogram, dorsal margin crenate. *Sulcus acusticus*: homosulcoid, mesial, median. *Ostium*: elliptic, similar to the cauda in size, slightly convex, ending close to the anterior margin. *Cauda*: elliptic, slightly convex, ending close to the posterior margin. *Anterior region*: round, with a small protuberance in the anterior-dorsal region. *Posterior region*: peaked.

OL/CL	OH/OL	Circularity	Rectangularity
1.6-1.7	36.3-37.5	19.0-20.4	0.5

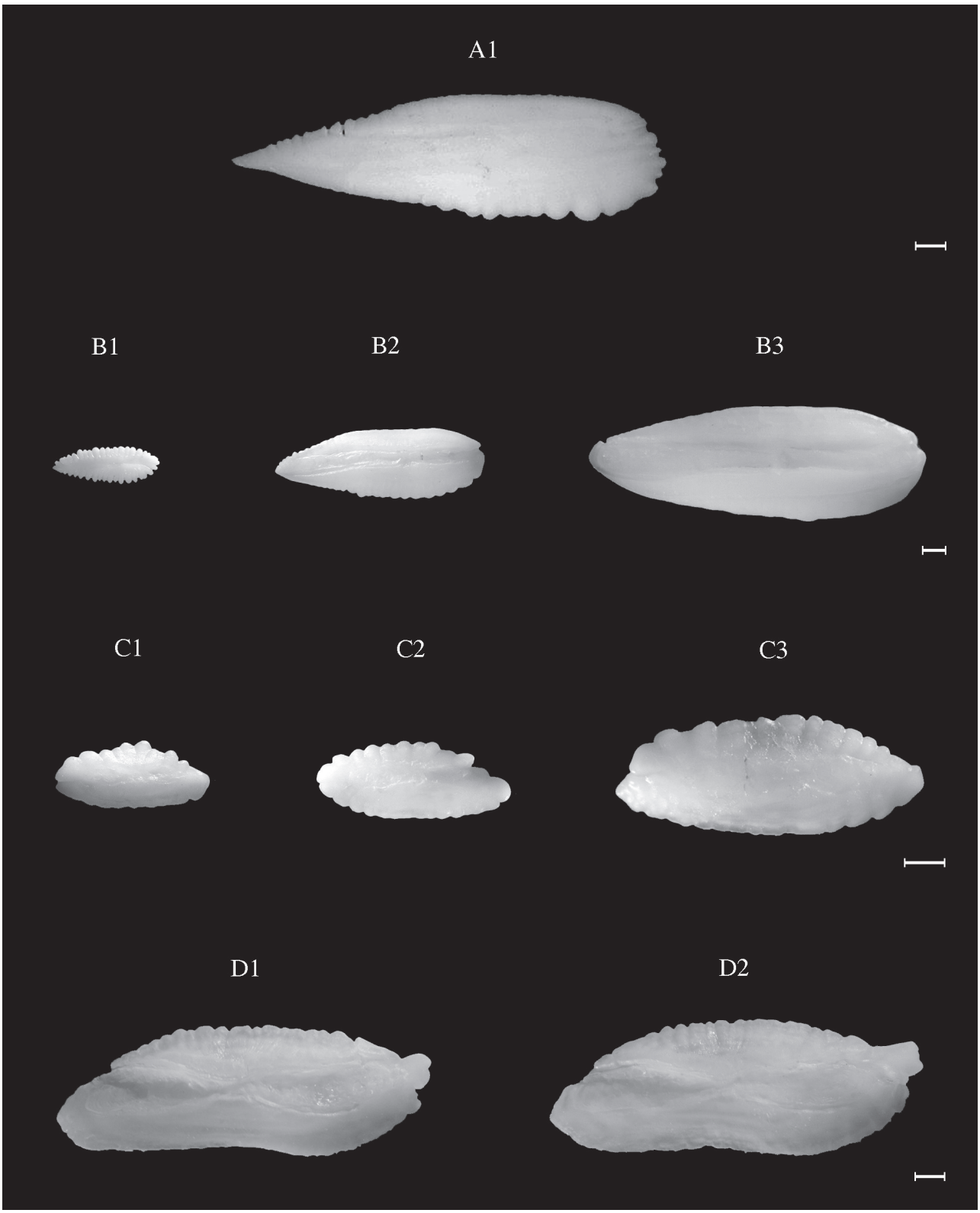

FIG. 31. – *Merlangius merlangus* (CEA). TL: A1, no data available.
Micromesistius poutassou. TL: B1, 9.0 cm (WM); B2, 17.0 cm (WM); B3, 30.2 cm (NEA).
Molva dypterygia (WM). TL: C1, 18.0; C2, 24.0 cm; C3, 34.0 cm.
Molva molva (NEA). TL: D1, 70.0 cm; D2, 73.7 cm.
Scale bar = 1 mm.

Trisopterus luscus (Linnaeus, 1758) Family GADIDAE

Shape: lanceolated to oblong, anterior region more globose, margins sinuated in the smaller otoliths. *Sulcus acusticus*: heterosulcoid, pseudo-ostiocaudal, median. *Ostium*: approximately rectangular, broad, shorter than the cauda. *Cauda*: approximately elliptic, slightly sinuous, as wide as the ostium. *Anterior region*: oblique. *Posterior region*: lanceolated to peaked.

OL/TL	OH/OL	Circularity	Rectangularity
3.1-5.3	48.2-49.6	16.4-17.6	0.3-0.4

Trisopterus minutus (Linnaeus, 1758) Family GADIDAE

Shape: lanceolated to oblong, anterior region more globose, margins sinuated in the smaller otoliths. *Sulcus acusticus*: heterosulcoid, pseudo-ostiocaudal, median. *Ostium*: elliptic, broad, shorter than the cauda. *Cauda*: elliptic-tubular, sinuous, as wide as the ostium. *Anterior region*: round to oblique. *Posterior region*: lanceolated to peaked.

OL/TL	OH/OL	Circularity	Rectangularity
4.5-5.6	44.1-49.5	16.9-17.8	0.3-0.4

Order OPHIDIIFORMES

Carapus acus (Cocco, 1829) Family CARAPIDAE

Shape: oval to elliptic. *Sulcus acusticus*: archaesulcoid, mesial, inframedian. *Ostium and cauda*: undifferentiated, close to the anterior margin, but ending far from the posterior one. *Anterior region*: round. *Posterior region*: round to peaked.

OL/TL	OH/OL	Circularity	Rectangularity
2.0-2.4	52.1-63.3	13.8-15.6	0.2-0.3

Echiodon dentatus (Risso, 1810) Family CARAPIDAE

Shape: elliptic, antero-dorsal margin lobed. *Sulcus acusticus*: archaesulcoid, mesial, median to slightly inframedian. *Ostium and cauda*: undifferentiated, very wide, ending close to the anterior and postero-ventral margins. *Anterior region*: round to angled. *Posterior region*: peaked.

OL/TL	OH/OL	Circularity	Rectangularity
1.8-3.1	47.6-56.9	14.6-16.4	0.3-0.4

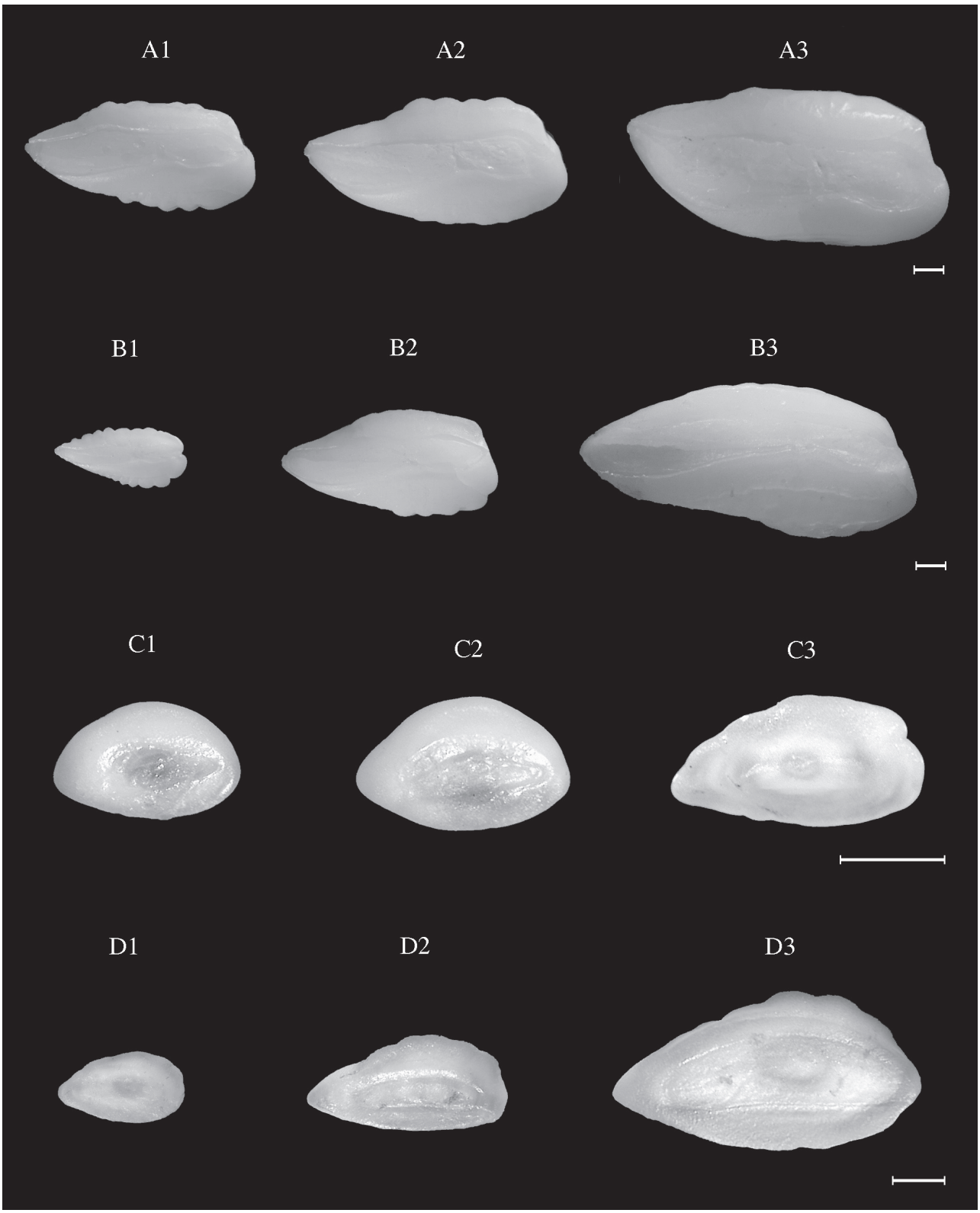

FIG. 32. – *Trisopterus luscus* (NEA). TL: A1 13.9 cm; A2, 21.3 cm; A3, 27.2 cm.
Trisopterus minutus. TL: B1, 7.5 cm (NEA); B2, 14.7 cm (NEA); B3, 24.0 cm (WM).
Carapus acus (WM). TL: C1, 8.0 cm; C2, 8.5 cm; C3, 12.0 cm.
Echiodon dentatus (WM). TL: D1, 13.0 cm; D2, 14.7 cm; D3, 18.5 cm.
Scale bar = 1 mm.

Benthocometes robustus Rafinesque, 1810 Family OPHIDIIDAE

Shape: oval, with a round anterior-dorsal prominence. *Sulcus acusticus*: heterosulcoid, paraostial with a narrow channel opening in the anterior region, median. *Ostium*: elliptic, ascending, longer than the cauda tapering to the ventral margin. *Cauda*: elliptic, ascending, ending close to the posterior-dorsal margin. *Anterior region*: angled to irregular; rostrum poorly defined, very short, broad, round; antirostrum and excisura absent. *Posterior region*: round.

OL/TL	OH/OL	Circularity	Rectangularity
3.6-5.0	69.1-72.7	13.6-13.9	0.2

Ophidion barbatum Linnaeus, 1758 Family OPHIDIIDAE

Shape: elliptic, with a round, very prominent anterior-dorsal region. *Sulcus acusticus*: heterosulcoid, paraostial with a narrow channel opening in the anterior region, median. *Ostium*: elliptic, longer than the cauda tapering to the ventral margin. *Cauda*: elliptic, ending close to the posterior-dorsal margin. *Anterior region*: oblique to flattened; rostrum poorly defined, very short, broad, round; antirostrum and excisura absent. *Posterior region*: round to angled.

OL/TL	OH/OL	Circularity	Rectangularity
3.4-4.0	70.1-72.5	13.8-14.5	0.2

Ophidion rochei Müller, 1845 Family OPHIDIIDAE

Shape: elliptic. *Sulcus acusticus*: heterosulcoid, paraostial with a narrow channel opening in the anterior region, median. *Ostium*: elliptic, longer than the cauda tapering to the ventral margin. *Cauda*: elliptic, ending close to the posterior-dorsal margin. *Anterior region*: oblique to flattened; rostrum poorly defined, very short, broad, round; antirostrum and excisura absent. *Posterior region*: peaked.

OL/TL	OH/OL	Circularity	Rectangularity
3.4	68.8	14.6	0.2

Bellottia apoda (Reinhardt, 1837) Family BYTHITIDAE

Shape: oval. *Sulcus acusticus*: archaesulcoid, mesial, median. *Ostium and cauda*: undifferentiated, ending far from both the anterior and posterior margins. *Anterior region*: round with tapered tip. *Posterior region*: round.

OL/TL	OH/OL	Circularity	Rectangularity
5.5	57.8	14.3	0.3

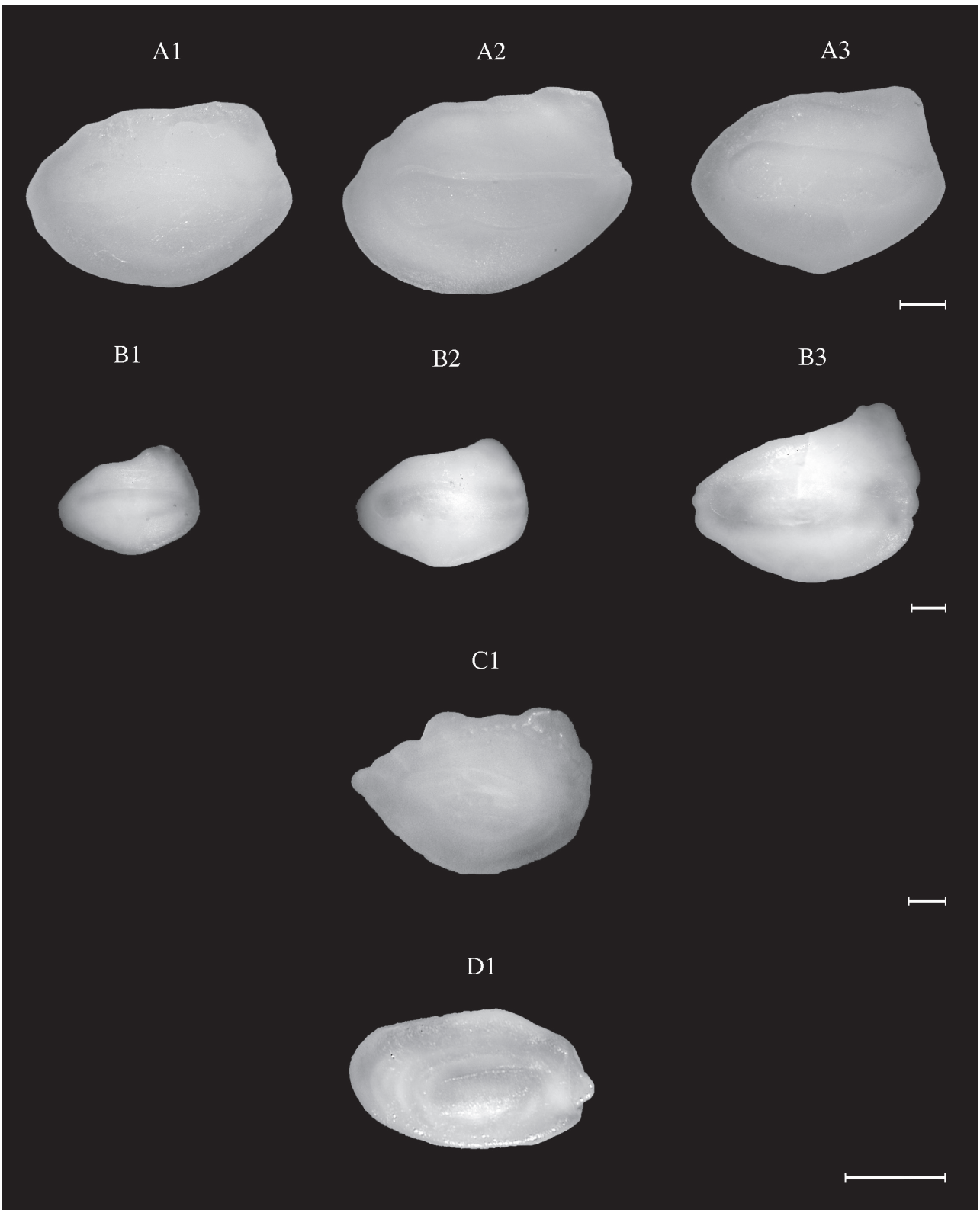

FIG. 33. – *Benthocometes robustus.* TL: A1, 11.2 cm (CEA); A2, 12.6 cm (NEA); A3, 14.7 cm (CEA).
Ophidion barbatum (WM). TL: B1, 10.0 cm; B2, 14.0 cm; B3, 19.0 cm.
Ophidion rochei (WM). TL: C1, 18.5 cm.
Bellottia apoda (WM). TL: D1, 4.5 cm.
Scale bar = 1 mm.

Cataetyx alleni (Byrne, 1906) Family BYTHITIDAE

Shape: elliptic. *Sulcus acusticus*: archaesulcoid, mesial, median. *Ostium and cauda*: undifferentiated, ending far from both the anterior and posterior margins. *Anterior region*: peaked. *Posterior region*: round to peaked.

OL/TL	OH/OL	Circularity	Rectangularity
4.3-4.5	49.3-51.2	15.0-15.4	0.3

Cataetyx laticeps Koefoed, 1927 Family BYTHITIDAE

Shape: elliptic to oblong, dorsal margin entire to lobed. *Sulcus acusticus*: archaesulcoid, mesial, inframedian to median. *Ostium and cauda*: undifferentiated, ending far from both the anterior and posterior margins. *Anterior region*: round to round-oblique. *Posterior region*: peaked.

OL/TL	OH/OL	Circularity	Rectangularity
2.8-4.1	42.5-48.7	15.5-18.4	0.3-0.4

Order BATRACHOIDIFORMES

Halobatrachus didactylus (Bloch and Schneider, 1801) Family BATRACHOIDIDAE

Shape: elliptic, with a clear indentation in the middle of the dorsal margin, ventral margin lobed, posteroventral margin with a conspicuous serrate margin. *Sulcus acusticus*: heterosulcoid, ostial, median to supramedian in the larger otoliths. *Ostium*: bent, shorter than the cauda. *Cauda*: elliptic, straight, ending close to the posterior margin. *Anterior region*: round or blunt; rostrum short, broad, round or blunt; antirostrum absent or very short, broad, round; excisura wide, with or without an acute notch. *Posterior region*: pointed-oblique to pointed.

OL/TL	OH/OL	Circularity	Rectangularity
2.4-3.6	51.9-58.6	18.5-28.1	0.3

Order LOPHIIFORMES

Lophius budegassa Spinola, 1807 Family LOPHIIDAE

Shape: semicircular, dorsal margin lobed to irregular with deep indentations. *Sulcus acusticus*: archaesulcoid (it may appear heterosulcoid), mesial, slightly convex and supramedian to median in the larger otoliths, kidney-shaped, broad, crista inferior more evident than crista superior. *Ostium and cauda*: undifferentiated. *Anterior and posterior regions*: oblique and irregular, with blunt end in the larger otoliths.

OL/TL	OH/OL	Circularity	Rectangularity
1.8-2.9	59.0-64.0	15.4-21.3	0.2-0.3

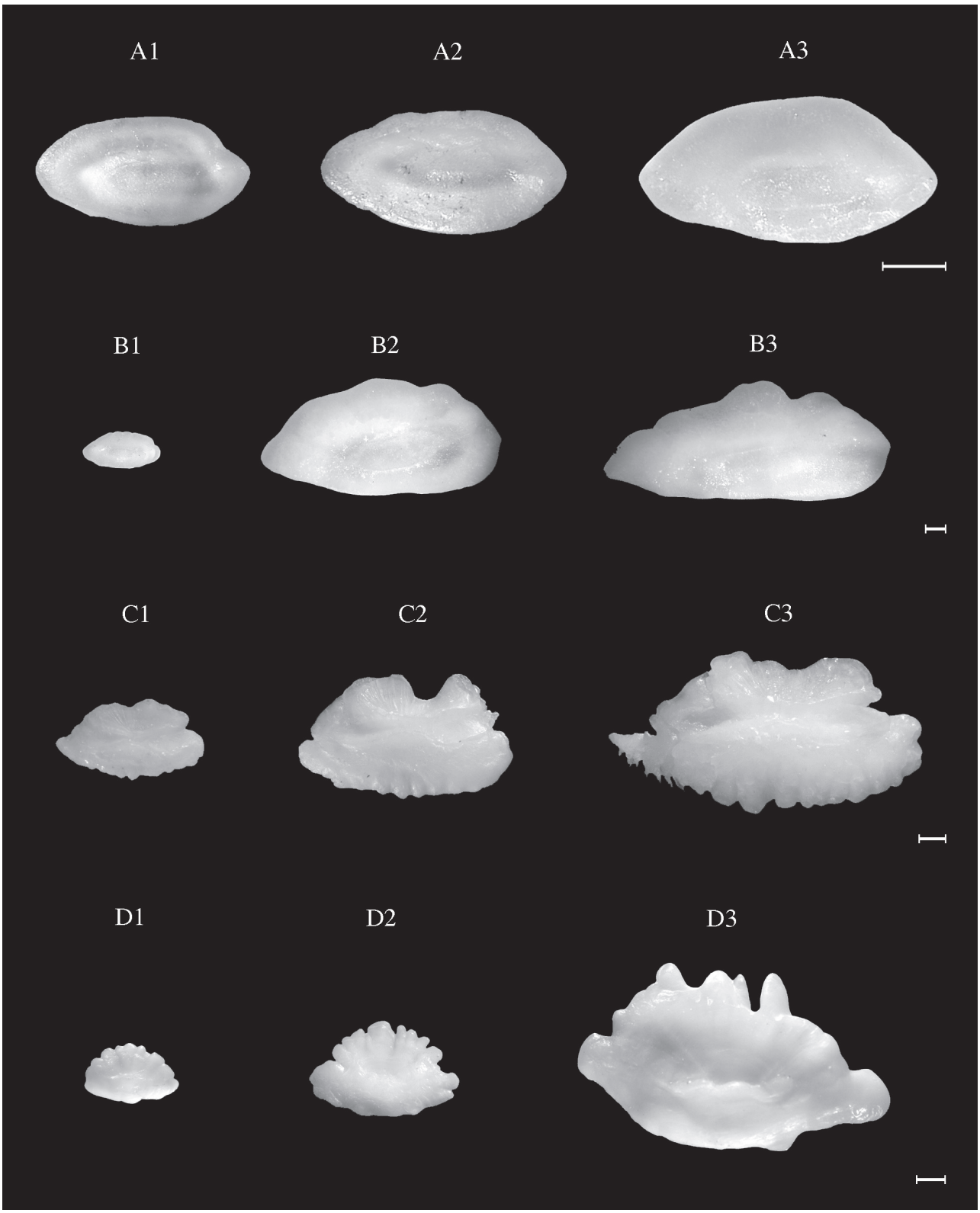

FIG. 34. – *Cataetyx alleni* (WM). TL: A1, 7.5 cm; A2, 9.0 cm; A3, 10.5 cm.
Cataetyx laticeps (WM). TL: B1, 9.0 cm; B2, 34.5 cm; B3, 48.5 cm.
Halobatrachus didactylus (NEA). TL: C1, 15.0 cm; C2, 30.2 cm; C3, 47.2 cm.
Lophius budegassa. TL: D1, 11.0 cm (WM); D2, 21.1 cm (NEA); D3, 57.0 cm (WM).
Scale bar = 1 mm.

Lophius piscatorius Linnaeus, 1758 Family LOPHIIDAE

Shape: semicircular, with dorsal margin lobed. *Sulcus acusticus*: archaesulcoid (it may appear heterosulcoid), mesial, slightly convex and supramedian to median in the larger otoliths, kidney-shaped, broad, crista inferior more evident than crista superior. *Ostium and cauda*: undifferentiated. *Anterior and posterior regions*: oblique and irregular, with pointed end in the larger otoliths.

OL/TL	OH/OL	Circularity	Rectangularity
1.4-1.7	62.6-73.4	14.4-17.5	0.2

Order MUGILIFORMES

Chelon labrosus (Risso, 1827) Family MUGILIDAE

Shape: rectangular, with antero-dorsal area more developed in the larger otoliths, ventral margin crenate to irregular with identations. *Sulcus acusticus*: heterosulcoid, ostial, supramedian. *Ostium*: funnel-like, much shorter than the cauda. *Cauda*: tubular, slightly sinuous occupying the postero-dorsal area, strongly flexed posteriorly, ending close to the posterior margin. *Anterior region*: round to angled-irregular; rostrum very short, broad, round; antirostrum absent; excisura moderately wide without a notch. *Posterior region*: round to flattened-irregular.

OL/TL	OH/OL	Circularity	Rectangularity
2.1-3.2	47.2-59.6	18.7-22.5	0.3-0.4

Liza aurata (Risso, 1810) Family MUGILIDAE

Shape: rectangular to oblong, with anterior-dorsal area more developed in the larger otoltihs, irregular margins. *Sulcus acusticus*: heterosulcoid, ostial, supramedian. *Ostium*: funnel-like, much shorter than the cauda. *Cauda*: tubular, slightly sinuous, occupying the postero-dorsal area, strongly flexed posteriorly, ending close to the posterior margin. *Anterior region*: angled-round; rostrum very short, broad, round; antirostrum absent; excisura moderately wide without a notch. *Posterior region*: round to irregular.

OL/TL	OH/OL	Circularity	Rectangularity
2.0-3.5	47.0-59.9	17.8-29.6	0.3-0.4

Liza ramada (Risso, 1810) Family MUGILIDAE

Shape: elliptic to rectangular, with ventral margin irregular. *Sulcus acusticus*: heterosulcoid, ostial, supramedian. *Ostium*: funnel-like, much shorter than the cauda. *Cauda*: tubular, sinuous, occupying the postero-dorsal area, markedly flexed posteriorly, ending close to the posterior margin. *Anterior region*: round to irregular; rostrum very short, broad, round; antirostrum absent; excisura moderately wide without a notch. *Posterior region*: round or angled.

OL/TL	OH/OL	Circularity	Rectangularity
2.3-3.5	43.7-53.8	16.3-18.2	0.3-0.4

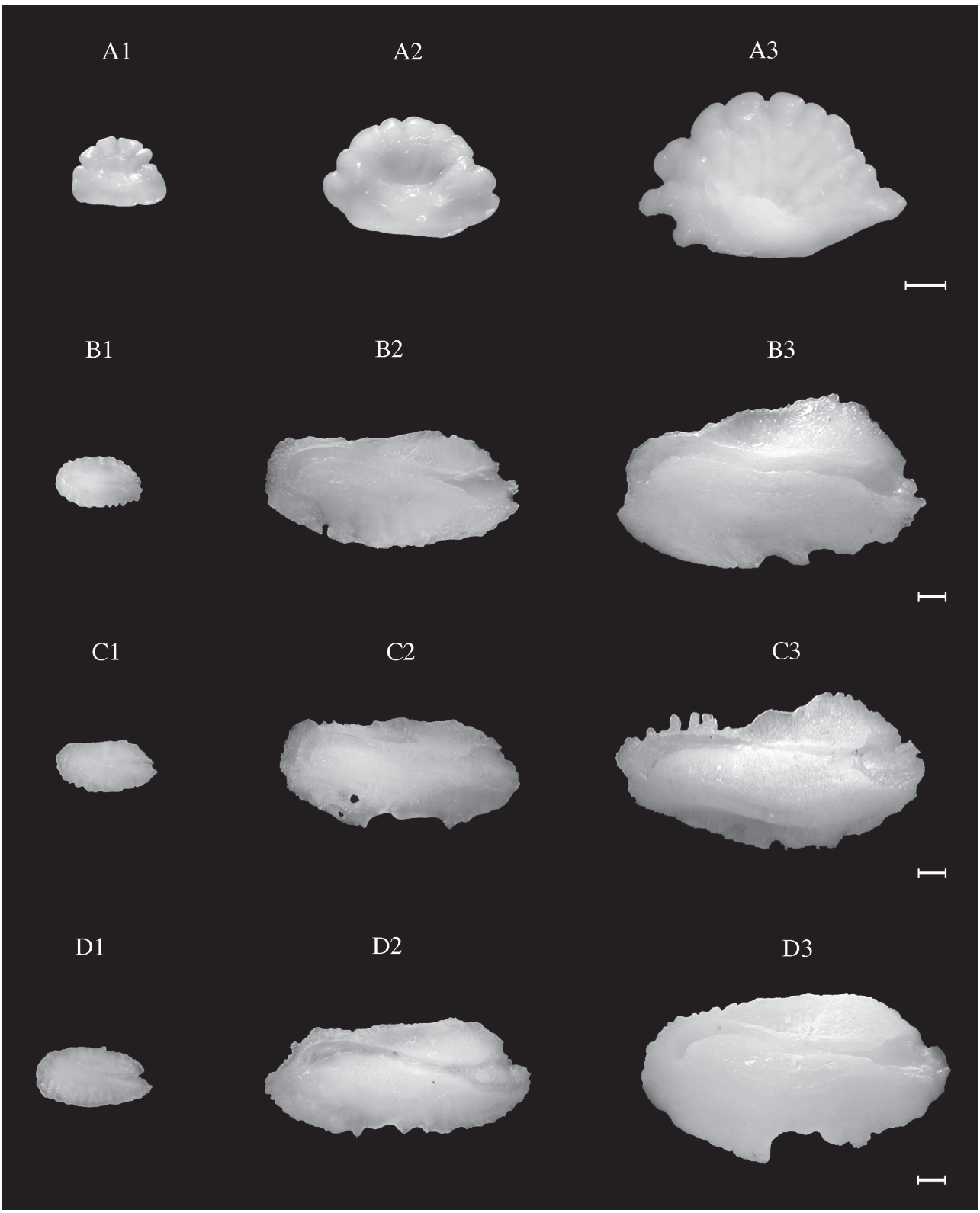

FIG. 35. – *Lophius piscatorius*. TL: A1, 15.0 cm (WM); A2, 25.0 cm (WM); A3, 45.6 cm (NEA).
Chelon labrosus. TL: B1, 10.1 cm (NEA); B2, 37.9 cm (CEA); B3, 53.0 cm (WM).
Liza aurata. TL: C1, 101. cm (NEA) ; C2, 33.3 cm (NEA); C3, 58.5 cm (WM).
Liza ramada. TL: D1, 12.1 cm (NEA); D2, 37.0 cm (WM); D3, 51.0 cm (WM).
Scale bar = 1 mm.

Liza saliens (Risso, 1810) Family MUGILIDAE

Shape: rectangular, with ventral margin irregular. *Sulcus acusticus*: heterosulcoid, ostial, supramedian. *Ostium*: funnel-like, much shorter than the cauda. *Cauda*: tubular, sinuous, occupying the postero-dorsal area, markedly flexed posteriorly, ending close to the posterior margin. *Anterior region*: round to irregular; rostrum very short, broad, blunt; antirostrum poorly defined or very small, broad, round; excisura moderately wide with or without a shallow notch. *Posterior region*: round.

OL/TL	OH/OL	Circularity	Rectangularity
2.8-3.4	39.8-49.6	12.3-17.9	0.3-0.4

Mugil cephalus Linnaeus, 1758 Family MUGILIDAE

Shape: oblong to rectangular. *Sulcus acusticus*: heterosulcoid, ostial, supramedian. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: tubular, straight or only slightly curved, occupying the postero-dorsal area, ending far from to the posterior margin. *Anterior region*: angled to round; rostrum very short, broad, slightly pointed to round; antirostrum absent; excisura moderately wide without a notch. *Posterior region*: flattened to round.

OL/TL	OH/OL	Circularity	Rectangularity
2.1-3.8	45.0-56.3	18.9-24.5	0.3-0.4

Order ATHERINIFORMES

Atherina boyeri Risso, 1810 Family ATHERINIDAE

Shape: elliptic. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: tubular, straight or slightly curved, slightly flexed posteriorly in the larger otoliths, ending close to the posterior margin. *Anterior region*: peaked; rostrum short, broad, slightly pointed or blunt; antirostrum absent or small, broad, peaked; excisura wide with or without an acute notch. *Posterior region*: round.

OL/TL	OH/OL	Circularity	Rectangularity
3.2-4.2	66.9-71.0	15.4-17.9	0.2

Atherina presbyter Cuvier, 1829 Family ATHERINIDAE

Shape: elliptic. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: tubular, straight or slightly curved, slightly flexed posteriorly in the larger otoliths, ending close to the posterior margin. *Anterior region*: peaked; rostrum short, broad, pointed; antirostrum small, broad, round; excisura wide with or without a shallow notch. *Posterior region*: round.

OL/TL	OH/OL	Circularity	Rectangularity
3.5-3.6	66.1-73.2	16.4-17.2	0.2

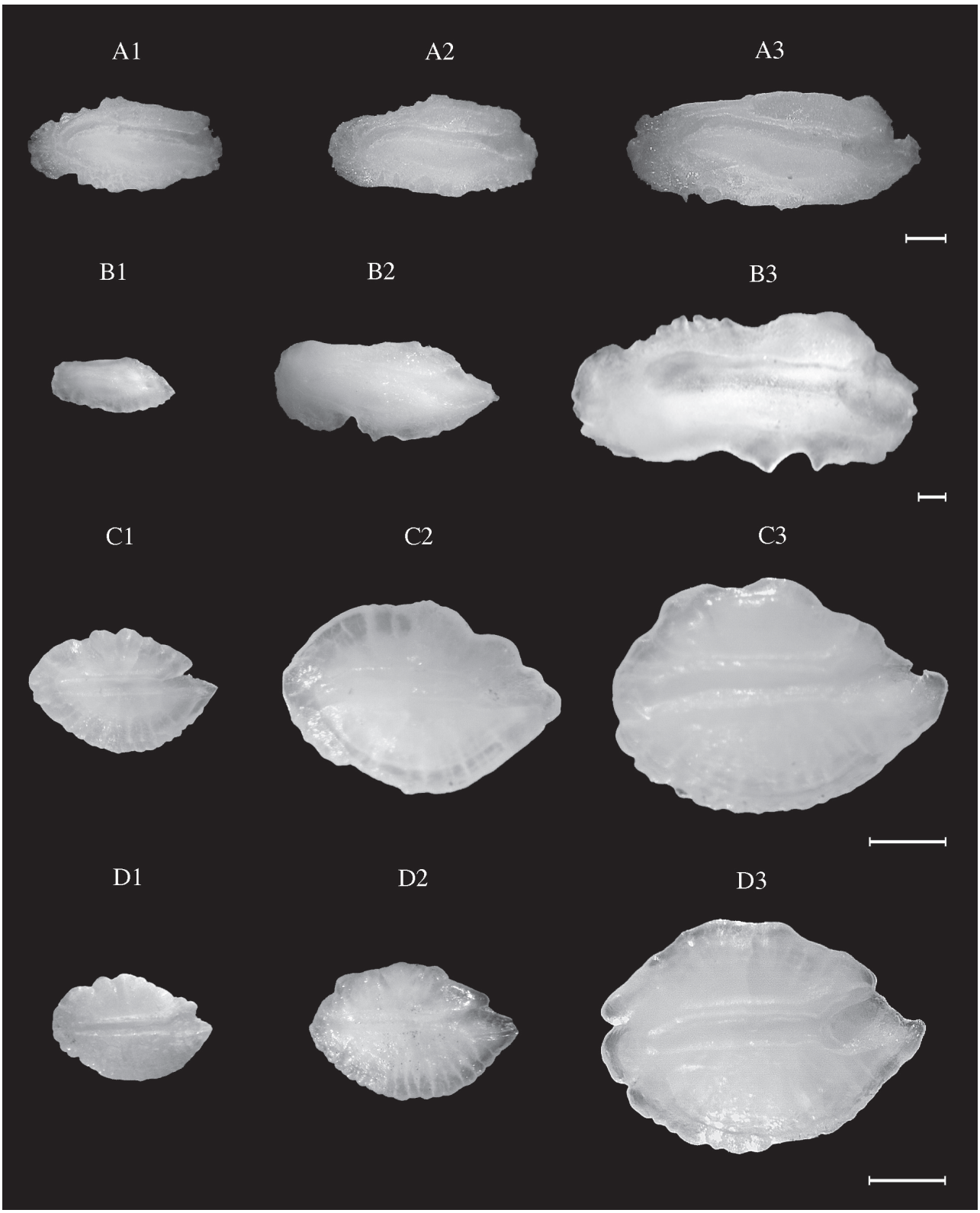

FIG. 36. – *Liza saliens* (WM). TL: A1, 14.0 cm; A2, 18.5 cm ; A3, 23.0 cm.
Mugil cephalus. TL: B1, 11.6 cm (NEA); B2, 32.6 cm (NEA); B3, 56.0 cm (WM).
Atherina boyeri (NEA). TL: C1, 6.0 cm; C2, 9.5 cm; C3, 13.7 cm.
Atherina presbyter. TL: D1, 5.8 cm (CEA); D2, 7.6 cm (CEA); D3, 12.1 cm (NEA).
Scale bar = 1 mm.

Order BELONIFORMES

Belone belone (Linnaeus, 1761) Family BELONIDAE

Shape: elliptic-lanceolate. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: tubular, straight, ending close to the posterior margin. *Anterior region*: peaked; rostrum short, broad, pointed; antirostrum absent or short, broad, pointed; excisura absent or wide with a deep notch. *Posterior region*: round.

OL/TL	OH/OL	Circularity	Rectangularity
1.1-1.2	39.4-47.6	17.7-21.5	0.4-0.5

Tylosurus acus (Lacepède, 1803) Family BELONIDAE

Shape: elliptic-lanceolate, antero-dorsal margin slightly sinuate. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: tubular, straight, ending close to the posterior margin. *Anterior region*: round; rostrum very small, broad, round; antirostrum absent; excisura relatively wide without a notch. *Posterior region*: round.

OL/TL	OH/OL	Circularity	Rectangularity
1.0	58.1	14.8	0.3

Order BERYCIFORMES

Gephyroberyx darwini (Johnson, 1866) Family TRACHICHTHYDAE

Shape: irregular, margins very irregular and with deep indentations. *Sulcus acusticus*: heterosulcoid, ostiocaudal, median. *Ostium*: discoidal. *Cauda*: tubular, curved, markely flexed posteriorly, ending in the posteroventral margin. *Anterior region*: round to flattened; rostrum short, broad, noticeably flexed to the dorsal region (tip very fragile, frequently broken); antirostrum poorly defined; excisura very wide. *Posterior region*: angled; postrostrum short, broad, blunt, curved to the ventral region; postantirostrum absent; excisura caudalis narrow with a deep round notch.

OL/TL	OH/OL	Circularity	Rectangularity
6.4	69.6	19.2	0.2

Hoplostethus mediterraneus Cuvier, 1829 Family TRACHICHTHYDAE

Shape: elliptic to irregular, with irregular, deep indentations in the dorsal margin more conspicuous in larger otoliths. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: discoidal, as long as the cauda. *Cauda*: tubular, curved, concave, ending close to the posterior margin. *Anterior region*: round to flattened, dorsal lobes could be prominent and even separated forming indentations; rostrum short, broad, pointed to truncated noticebly flexed to the dorsal region; antirostrum poorly defined or small, broad, it may appear as a dorsal lobe; excisura absent or narrow with a deep, acute notch. *Posterior region*: angled to irregular.

OL/TL	OH/OL	Circularity	Rectangularity
6.5-8.7	69.0-81.3	16.7-18.3	0.1-0.2

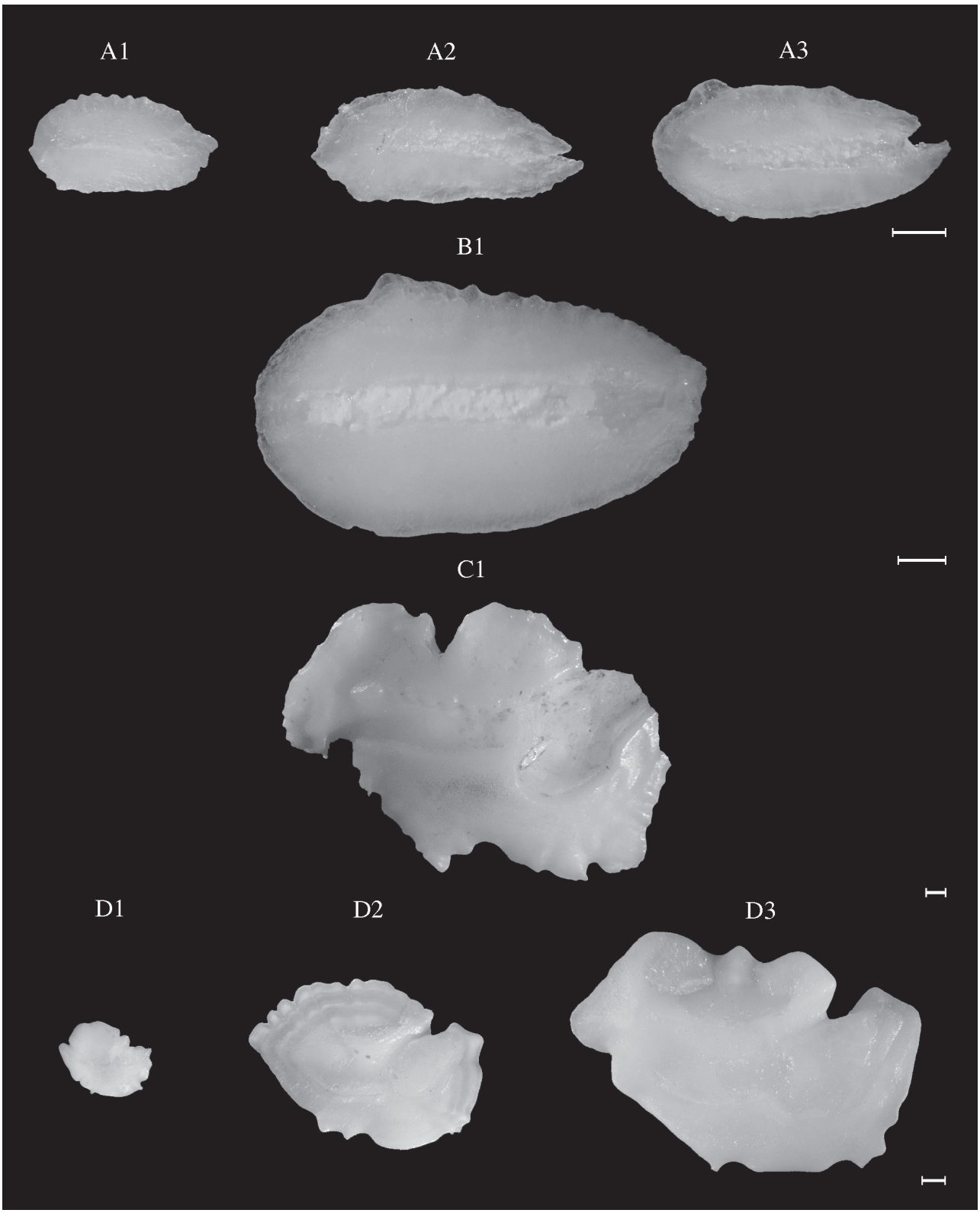

FIG. 37. – *Belone belone*. TL: A1, 32.7 cm (NEA); A2, 42.7 cm (CEA); A3, 50.0 cm (CEA).
Tylosurus acus (CEA). TL: B1, 91.5 cm.
Gephyroberyx darwini (CEA). TL: C1, 30.0 cm.
Hoplostethus mediterraneus. TL: D1, 5.8 cm (NEA); D2, 15.5 cm (CEA); D3, 26.0 cm (WM).
Scale bar = 1 mm.

Beryx decadactylus Cuvier, 1829 Family BERYCIDAE

Shape: Trapezoidal, more developed ventrally than dorsally, postero-ventral margin serrate. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: bent-concave, longer than the cauda. *Cauda*: tubular, straight, wider posteriorly, ending close to the posterior margin *Anterior region*: peaked; rostrum broad, very short, flattened or slightly pointed, slightly flexed to the dorsal region; antirostrum absent; excisura very narrow without a notch. *Posterior region*: round to oblique.

OL/TL	OH/OL	Circularity	Rectangularity
3.6-5.3	78.6-88.3	15.6-18.2	0.1

Beryx splendens Lowe, 1834 Family BERYCIDAE

Shape: Trapezoidal, more developed ventrally than dorsally, ventral margin from dentate (with indentations) to serrate. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: bent-concave, longer than the cauda. *Cauda*: tubular, straight, wider posteriorly, ending close to the posterior margin. *Anterior region*: peaked; rostrum short, broad, pointed or slightly flattened, slightly flexed to the dorsal region; antirostrum absent; excisura very narrow without a notch. *Posterior region*: angled to irregular.

OL/TL	OH/OL	Circularity	Rectangularity
3.8-4.4	71.6-82.8	15.7-21.9	0.1-02

Holocentrus adscensionis (Osbeck, 1765) Family HOLOCENTRIDAE

Shape: oblong. *Sulcus acusticus*: heterosulcoid, ostial, supramedian. *Ostium*: tubular, concave, uniformly wide, longer than the cauda. *Cauda*: tubular, sinuous, tapering posteriorly, ending very close to the posterior margin. *Anterior region*: blunt; rostrum short, broad, blunt; antirostrum poorly defined; excisura wide without a notch. *Posterior region*: round or angled, with a pointed end.

OL/TL	OH/OL	Circularity	Rectangularity
3.9	45.3	17.9	0.4

Order ZEIFORMES

Grammicolepis brachiusculus Poey, 1873 Family GRAMMICOLEPIDIDAE

Shape: hour-glass, asymmetric, slightly more developed ventrally; ventral margin with indentations. *Sulcus acusticus*: homosulcoid, ostio-caudal, median. *Ostium and cauda*: round to oval, small, separated by a massive collum, colliculi lanceolate, lobed and protruding between rostrum-antirostrum and postrostrum-postantirostrum. *Anterior region*: double-peaked; rostrum large, narrow and truncate; antirostrum long, broad, flattened, similar in size to the rostrum; excisura narrow with a wide, very deep notch. *Posterior region*: double-peaked; postrostrum long, broad, round; postantirostrum broad, lanceolate, shorter than the postrostrum; excisura caudalis narrow with a wide, very deep notch.

OL/TL	OH/OL	Circularity	Rectangularity
1.3	81.9	23.3	0.1

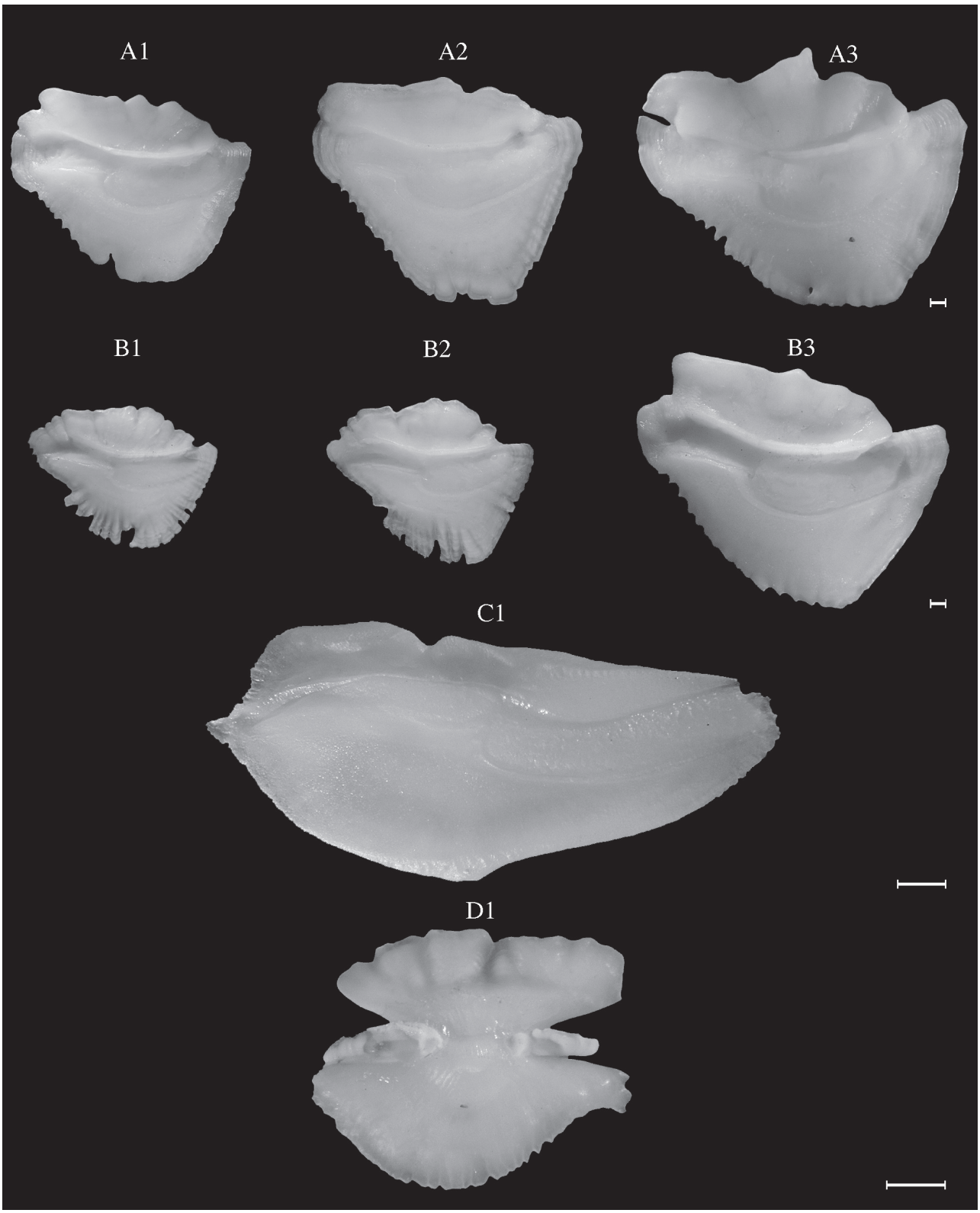

FIG. 38. – *Beryx decadactylus*. TL: A1, 31.5 cm (CEA); A2, 45.8 cm (NEA); A3, 54.2 cm (CEA).
Beryx splendens. TL: B1, 28.3 cm (CEA); B2, 30.9 cm (NEA); B3, 48.9 cm (CEA).
Holocentrus adscensionis (CEA). TL: C1, 30.3 cm.
Grammicolepis brachiusculus (CEA). SL, D1, 42.4 cm.
Scale bar = 1 mm.

Cyttopsis rosea (Lowe, 1843) Family ZEIDAE

Shape: hour-glass, asymmetric, more developed ventrally; ventral margin with small indentations. *Sulcus acusticus*: homosulcoid, ostio-caudal, median. *Ostium and cauda*: round-oval, small, separated by a massive collum. *Anterior region*: double-peaked; rostrum short, broad, slightly round or pointed; antirostrum broad, round, similar to the rostrum in size; excisura narrow with a wide, very deep notch. *Posterior region*: double-peaked; postrostrum and postantirostrum broad, short, round, postrostrum longer than postantirostrum; excisura caudalis narrow with a wide, very deep notch.

OL/TL	OH/OL	Circularity	Rectangularity
2.1-3.7	98.1-99.6	17.0-21.9	0.0

Zeus faber Linnaeus, 1758 Family ZEIDAE

Shape: trilobate to pentalobate, dorsal lobe wider than the ventral ones and inclined in the posterior direction, ventral lobes along a horizontal line and separated by a medium ventral round notch. *Sulcus acusticus*: homosulcoid, ostio-caudal, median. *Ostium and cauda*: roud-oval, small, collicullum lanceolate, lobed and extensively protrunding into both excisurae. *Anterior region*: notched, rostrum very large, round, blunt or truncated; excisura wide with a wide, very deep notch. *Posterior region*: notched; postrostrum very large, blunt, more slender than the rostral lobe; excisura caudalis wide with a wide, very deep notch.

OL/TL	OH/OL	Circularity	Rectangularity
0.7-1.2	70.8-82.4	24.6-37.0	0.1-0.2

Order GASTEROSTEIFORMES

Gasterosteus aculeatus Linnaeus, 1758 Family GASTEROSTEIDAE

Shape: squared. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: round-oval, as long as, or slightly shorter than the ostium, ending far from the posterior margin. *Anterior region*: round to slightly peaked; rostrum very short, broad and blunt; antirostrum absent or very short, broad and blunt; excisura wide without a notch. *Posterior region*: flattened.

OL/TL	OH/OL	Circularity	Rectangularity
1.0	0.9-1.0	14.0-15.0	0.5

Hippocampus hippocampus (Linnaeus, 1758) Family SYNGNATHIDAE

Shape: oval, medial face strongly concave. *Sulcus acusticus*: heterosulcoid, ostial, median, long, ending far from the posterior margin of the otolith. *Ostium and cauda*: not clearly differentiated. *Anterior region*: round; rostrum short, broad, round; antirostrum absent; excisura with a very shallow round or angled, obtuse notch. *Posterior region*: round.

OL/TL	OH/OL	Circularity	Rectangularity
0.3	70.4-74.6	13.9-14.4	0.2

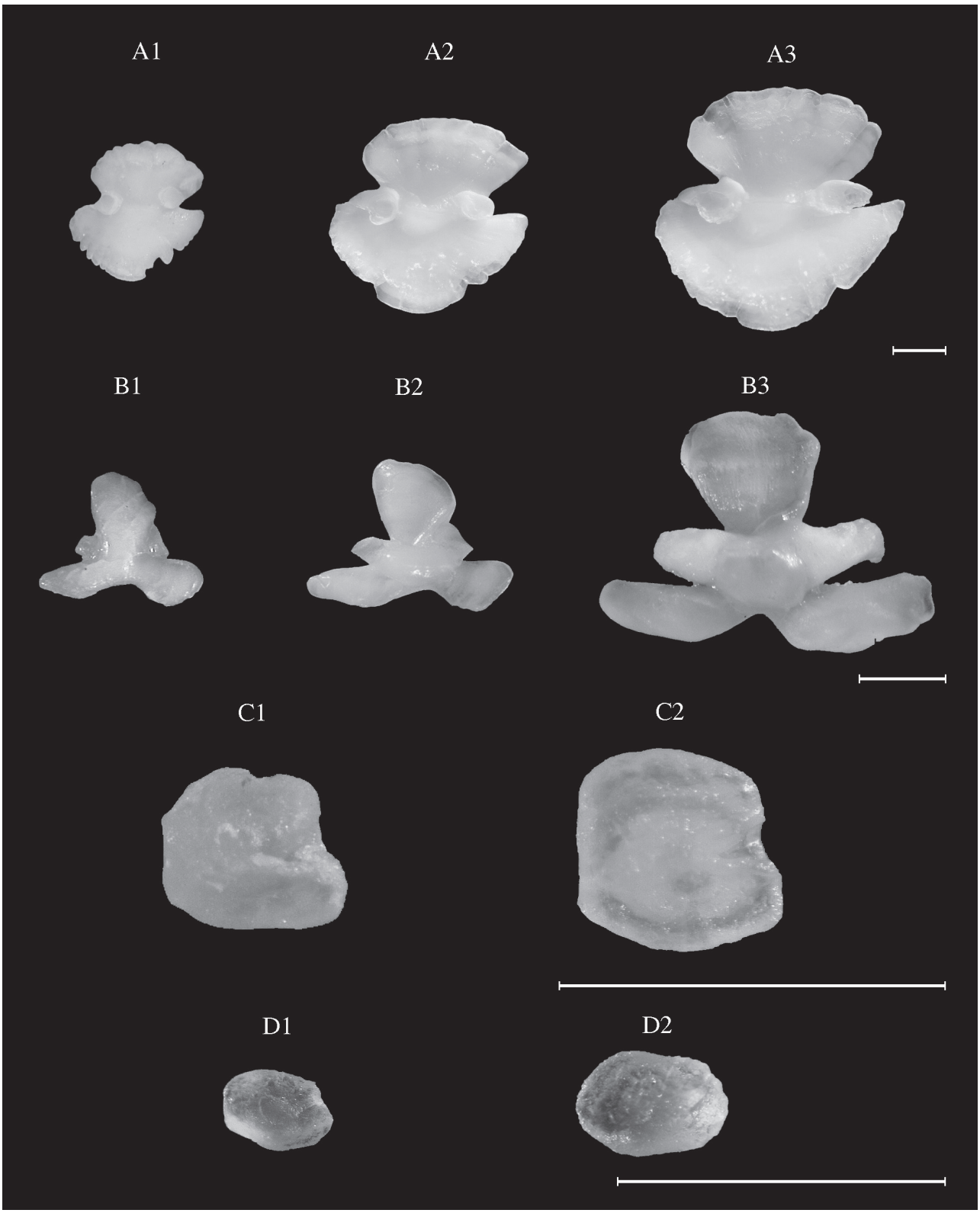

FIG. 39. – *Cyttopsis rosea*. TL: A1, 7.5 cm (CEA); A2, 17.5 cm (NEA); A3, 22.6 cm (NEA).
Zeus faber. TL: B1, 15.0 cm (WM); B2, 32.1 cm (NEA); B3, 54.0 cm (CEA)
Gasterosteus aculeatus (NEA). TL: C1 4.4 cm; C2, 5.8 cm.
Hippocampus hippocampus (NEA). TL: D1, 10.5 cm; D2, 14.3 cm.
Scale bar = 1 mm.

Syngnathus abaster Risso, 1827 Family SYNGNATHIDAE

Shape: rectangular. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, slightly shorter to as long as the cauda. *Cauda*: tubular, straight, occupying a large portion of the medial face, ending close to the posterior margin. *Anterior region*: double-peaked; rostrum and antirostrum not very prominent, short, broad, round, rostrum longer or as long as the antirostrum; excisura wide without a notch. *Posterior region*: round to irregular.

OL/TL	OH/OL	Circularity	Rectangularity
0.3	50.0-57.9	15.5-17.2	0.3

Syngnathus acus Linnaeus, 1758 Family SYNGNATHIDAE

Shape: elliptic to rectangular. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: tubular, straight, ending far from the posterior margin. *Anterior region*: round to double-peaked, not very prominent; rostrum and antirostrum short, broad, round or pointed; excisura wide with or without an acute notch. *Posterior region*: oblique to round.

OL/TL	OH/OL	Circularity	Rectangularity
0.2	43.6-64.0	15.3-20.9	0.2-0.4

Syngnathus typhle Linnaeus, 1758 Family SYNGNATHIDAE

Shape: elliptic to rectangular. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: tubular, straight, ending far from the posterior margin. *Anterior region*: round to oblique; rostrum poorly developed or very short, broad, round; antirostrum absent; excisura wide without a notch. *Posterior region*: round to oblique.

OL/TL	OH/OL	Circularity	Rectangularity
0.2	43.6-64.0	15.3-20.9	0.2-0.4

Macroramphosus spp. Family MACRORAMPHOSIDAE

Shape: hour-glass, asymmetric with the ventral area more developed and with a clear indentation next to the posterior region. Maximum thickness of the dorsal lobe post-median in *M. gracilis* and median in *M. scolopax*. *Sulcus acusticus*: heterosulcoid, ostio-caudal. *Ostium*: funnel-like, shorter than the cauda, collicullum lobed and protrunding in the excisura. *Cauda*: funnel-like. *Anterior region*: double-peaked not very prominent; rostrum and antirostrum short to long, broad, pointed, rostrum longer; excisura very wide with an acute notch. Ventral margin of the antirostrum forming an acute angle with the upper margin of the colliculum ostii in *M. gracilis* and a slightly obtuse angle in *M. scolopax*. *Posterior region*: double-peaked not very prominent, postrostrum sharply acute and pointed; postantirostrum small, short and round; excisura caudalis very wide with an acute notch.

OL/TL	OH/OL	Circularity	Rectangularity
0.9-1.0	93.3-104.4	19.1-23.4	0.0

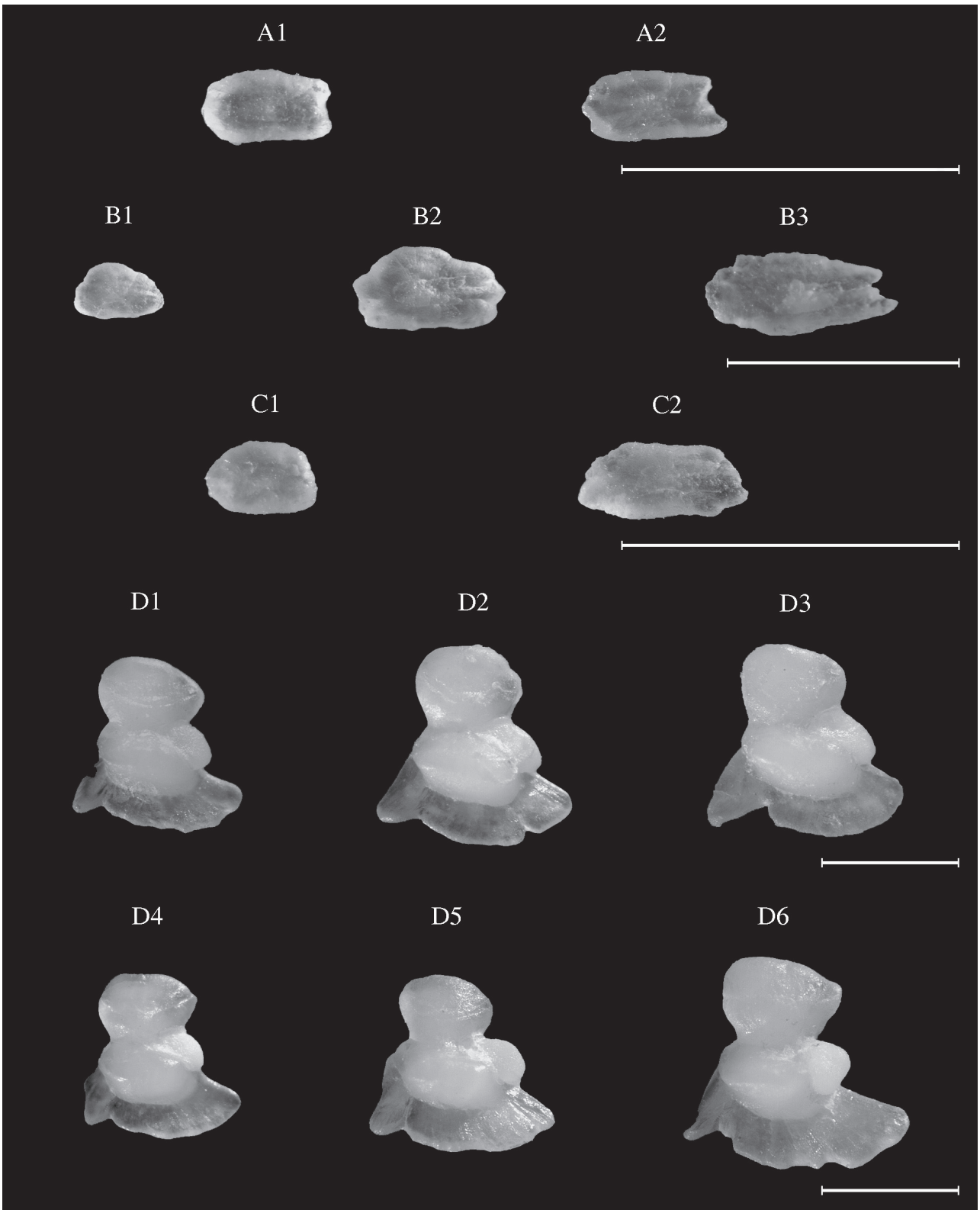

FIG. 40. – *Syngnathus abaster* (NEA). TL: A1, 14.5 cm; A2, 17.0 cm.
Syngnathus acus (NEA). TL: B1, 18.8 cm; B2, 32.3 cm; B3, 41.8 cm.
Syngnathus typhle (NEA). TL: C1, 23.3 cm; C2, 27.8 cm.
Macroramphosus gracilis (NEA). TL: D1, 11.3 cm; D2, 13.9 cm; D3, 16.8 cm.
Macroramphosus scolopax (NEA). TL: D4, 12.9 cm; D5, 15.5 cm; D6, 17.0 cm.
Scale bar = 1 mm.

Order SCORPAENIFORMES

Dactylopterus volitans (Linnaeus, 1758) Family DACTYLOPTERIDAE

Shape: oval. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: tubular, curved, noticeably flexed from the middle region, ending close to the posterior margin. *Anterior region*: peaked; rostrum short, very broad, blunt; antirostrum poorly defined to small, slightly pointed; excisura moderately wide with a conspicuous round notch. *Posterior region*: round to oblique.

OL/TL	OH/OL	Circularity	Rectangularity
0.8-1.1	62.5-74.7	20.1-24.0	0.1-0.2

Helicolenus dactylopterus (Delaroche, 1809) Family SCORPAENIDAE

Shape: elliptic. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, longer than the cauda. *Cauda*: tubular, straight, wider posteriorly, ending far from the posterior margin. *Anterior region*: peaked; rostrum moderately long, broad, pointed, curved to the dorsal region; antirostrum absent; excisura wide with a bite shaped notch in the larger otoliths. *Posterior region*: round to oblique.

OL/TL	OH/OL	Circularity	Rectangularity
3.5-4.5	50.3-57.5	15.7-18.3	0.3

Neomerinthe folgori (Postel and Roux, 1964) Family SCORPAENIDAE

Shape: oval, irregular margins. *Sulcus acusticus*: heterosulcoid, ostial, inframedian. *Ostium*: funnel-like, longer than the cauda. *Cauda*: tubular, straight, ending far from the posterior margin. *Anterior region*: peaked; rostrum short, broad, pointed, irregular, tip slightly curved to the dorsal region; antirostrum absent; excisura very wide and irregular without a notch. *Posterior region*: round to angled.

OL/TL	OH/OL	Circularity	Rectangularity
3.3	61.2	18.7	0.2

Pontinus kuhlii (Bowdich, 1825) Family SCORPAENIDAE

Shape: fusiform, serrate margins. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, longer than the cauda. *Cauda*: tubular, straight, wider posteriorly, ending far from the posterior margin. *Anterior region*: peaked; rostrum moderately long, broad, pointed, tip slightly curved to the dorsal region; antirostrum absent; excisura very wide without a notch. *Posterior region*: oblique.

OL/TL	OH/OL	Circularity	Rectangularity
4.2-4.8	46.9-48.2	17.9-19.0	0.4

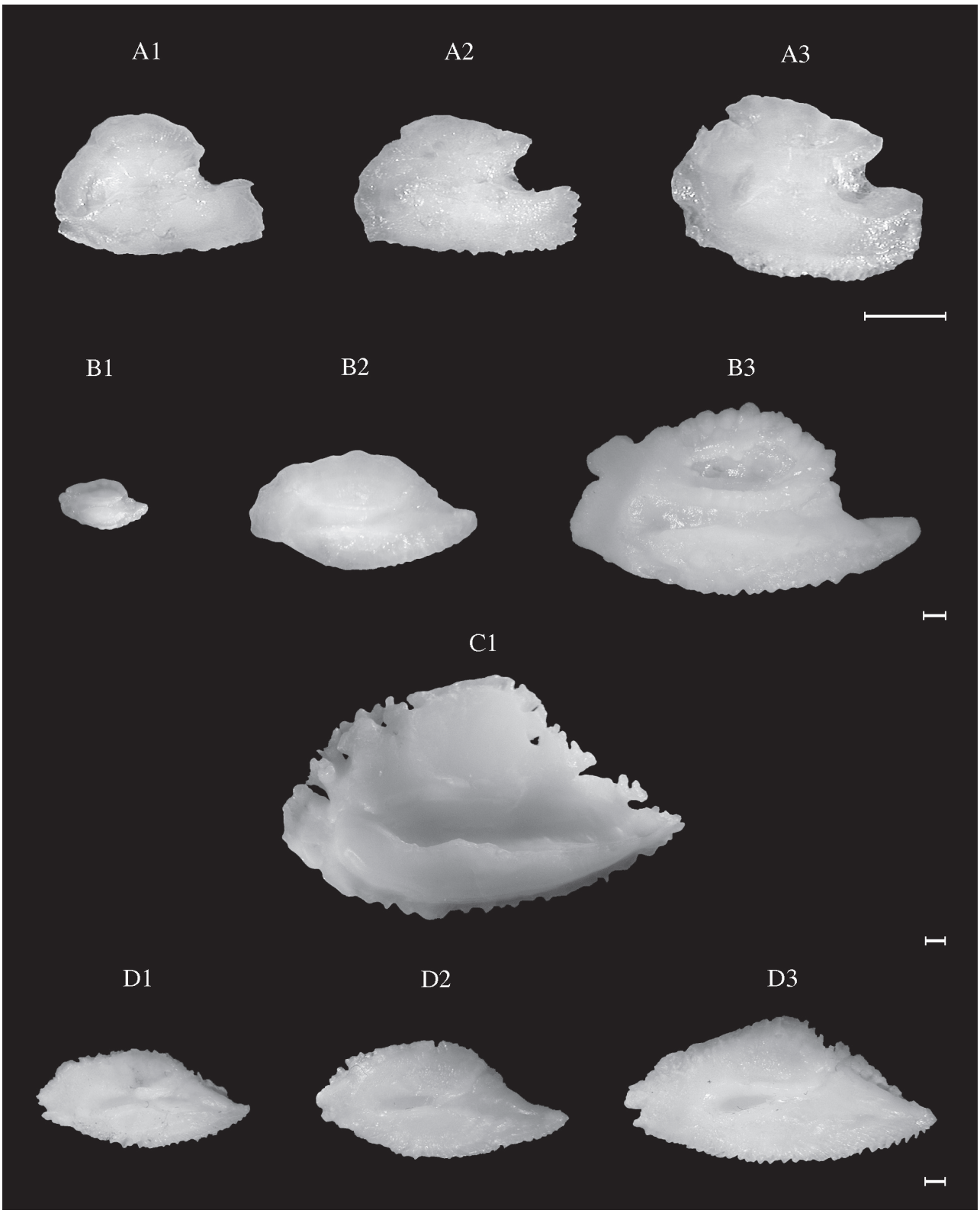

FIG. 41. – *Dactylopterus volitans* (WM). TL: A1, 24.5 cm; A2, 28.0 cm; A3, 36.5 cm.
Helicolenus dactylopterus. TL: B1, 8.5 cm (WM); B2, 23.6 cm (NEA); B3, 43.0 cm (CEA).
Neomerinthe folgori (CEA). TL: C1, 57.4 cm.
Pontinus kuhlii (CEA). TL: D1, 22.0 cm; D2, 29.5 cm; D3, 37.5 cm.
Scale bar = 1 mm.

Scorpaena elongata Cadenat, 1943 Family SCORPAENIDAE

Shape: oblong with sharp ends, antero-ventral margin crenate. *Sulcus acusticus*: heterosulcoid, ostial, medial. *Ostium*: funnel-like, slightly longer than the cauda. *Cauda*: tubular, curved, slightly flexed posteriorly, ending far from the posterior margin. *Anterior region*: peaked; rostrum moderately short, narrow, pointed to sharply pointed; antirostrum absent; excisura wide with or without a deep, acute notch. *Posterior region*: pointed to sharply pointed.

OL/TL	OH/OL	Circularity	Rectangularity
5.0-6.5	39.5-44.7	16.7-21.1	0.4

Scorpaena maderensis Valenciennes, 1833 Family SCORPAENIDAE

Shape: oblong, sinuate margins. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: tubular, curved, slightly flexed posteriorly, ending far from the the posterior margin. *Anterior region*: peaked; rostrum short, relatively broad, pointed; antirostrum absent; excisura wide with or without a shallow notch. *Posterior region*: oblique.

OL/TL	OH/OL	Circularity	Rectangularity
4.3	42.5	18.3	0.4

Scorpaena notata Rafinesque, 1810 Family SCORPAENIDAE

Shape: fusiform, ventral margin crenate. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, longer than the cauda. *Cauda*: elliptic, curved, slightly flexed posteriorly ending far from the posterior margin. *Anterior region*: peaked; rostrum short, relatively broad, pointed; antirostrum absent or small and pointed; excisura wide with or without a shallow notch. *Posterior region*: peaked to round-oblique.

OL/TL	OH/OL	Circularity	Rectangularity
5.3-6.1	43.3-46.4	16.8-19.9	0.4

Scorpaena porcus Linnaeus, 1758 Family SCORPAENIDAE

Shape: oblong, serrate margins. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, slightly shorter than the cauda. *Cauda*: tubular, curved, slightly flexed from the middle region ending close to the posterior-ventral margin. *Anterior region*: peaked; rostrum, short, relatively broad, pointed; antirostrum poorly defined or small and pointed; excisura wide with or without an acute notch. *Posterior region*: oblique to irregular with deep indentations.

OL/TL	OH/OL	Circularity	Rectangularity
3.5-3.9	30.5-41.2	21.6-23.5	0.4-0.5

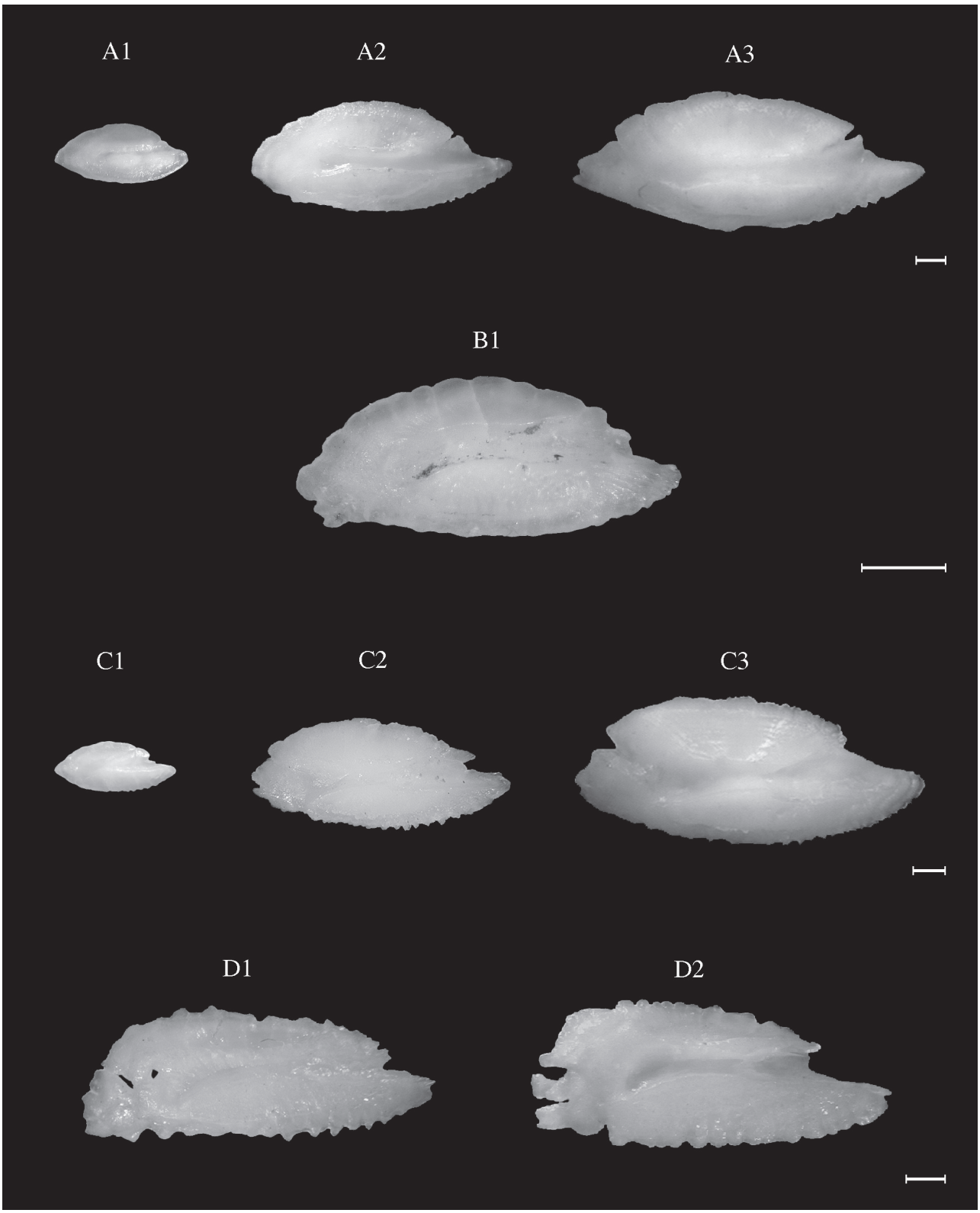

FIG. 42. – *Scorpaena elongata* (WM). TL: A1, 7.0 cm; A2, 17.0 cm; A3, 21.0 cm.
Scorpaena maderensis (CEA). TL: B1, 10.5 cm.
Scorpaena notata TL: C1, 7.0 cm (NEA); C2, 13.0 cm (CEA); C3, 20.0 cm (WM).
Scorpaena porcus TL: D1, 20.0 cm (CEA); D2, 22.5 cm (WM).
Scale bar = 1 mm.

Scorpaena scrofa Linnaeus, 1758 Family SCORPAENIDAE

Shape: elliptic to fusiform, margins crenate to irregular. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, longer than the cauda. *Cauda*: tubular, curved, wider posteriorly, slightly flexed posteriorly, ending close to the posterior-ventral margin. *Anterior region*: peaked; rostrum long, moderately narrow, pointed; antirostrum absent or small and pointed; excisura moderately wide with an acute notch in larger otoliths. *Posterior region*: round with a blunt or peaked end.

OL/TL	OH/OL	Circularity	Rectangularity
3.2-5.3	34.7-48.4	17.7-28.6	0.4-0.5

Setarches guentheri Johnson, 1862 Family SCORPAENIDAE

Shape: oval, maximum height in the middle region, dorsal margin sinuate. *Sulcus acusticus*: pseudo-archaesulcoid, ostial, median. *Ostium*: funnel-like, longer than the cauda. *Cauda*: tubular, slightly concave, ending very far from the posterior margin. *Anterior region*: peaked; rostrum relatively long, broad, round, tip slightly flexed to the dorsal region; antirostrum absent in small otoliths, broad, round in the larger ones; excisura very wide with an acute notch in larger otoliths. *Posterior region*: round or round to angled.

OL/TL	OH/OL	Circularity	Rectangularity
4.7-5.1	60.5-64.7	14.8-16.9	0.2-0.3

Aspitrigla cuculus (Linnaeus, 1758) Family TRIGLIDAE

Shape: approximately triangular to oval, sinuate margins. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, as long as the cauda. *Cauda*: tubular, curved, slightly ascending, wider and markedly flexed from the middle region, ending close to the posterior-dorsal margin. *Anterior region*: double-peaked; rostrum very short, broad, round or blunt; antirostrum shorter than the rostrum, small, broad, round to pointed; excisura wide with a shallow to acute notch. *Posterior region*: oblique to irregular.

OL/TL	OH/OL	Circularity	Rectangularity
1.7-2.5	69.4-76.1	17.4-20.1	0.1-0.2

Chelidonichthys obscurus (Bloch and Schneider, 1801) Family TRIGLIDAE

Shape: approximately triangular to oval, sinuate margins. *Sulcus acusticus*: heterosulcoid, ostial, supramedian. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: tubular, curved, ascending, wider and strongly flexed from the middle region, ending close to the posterior-dorsal margin. *Anterior region*: round to double-peaked, rostrum short, broad, round to slightly pointed; antirostrum absent to narrow, pointed, similar to the rostrum in size; excisura absent to narrow with a deep notch. *Posterior region*: oblique to irregular.

OL/TL	OH/OL	Circularity	Rectangularity
1.3-1.8	70.5-77.2	14.2-17.9	0.1-0.2

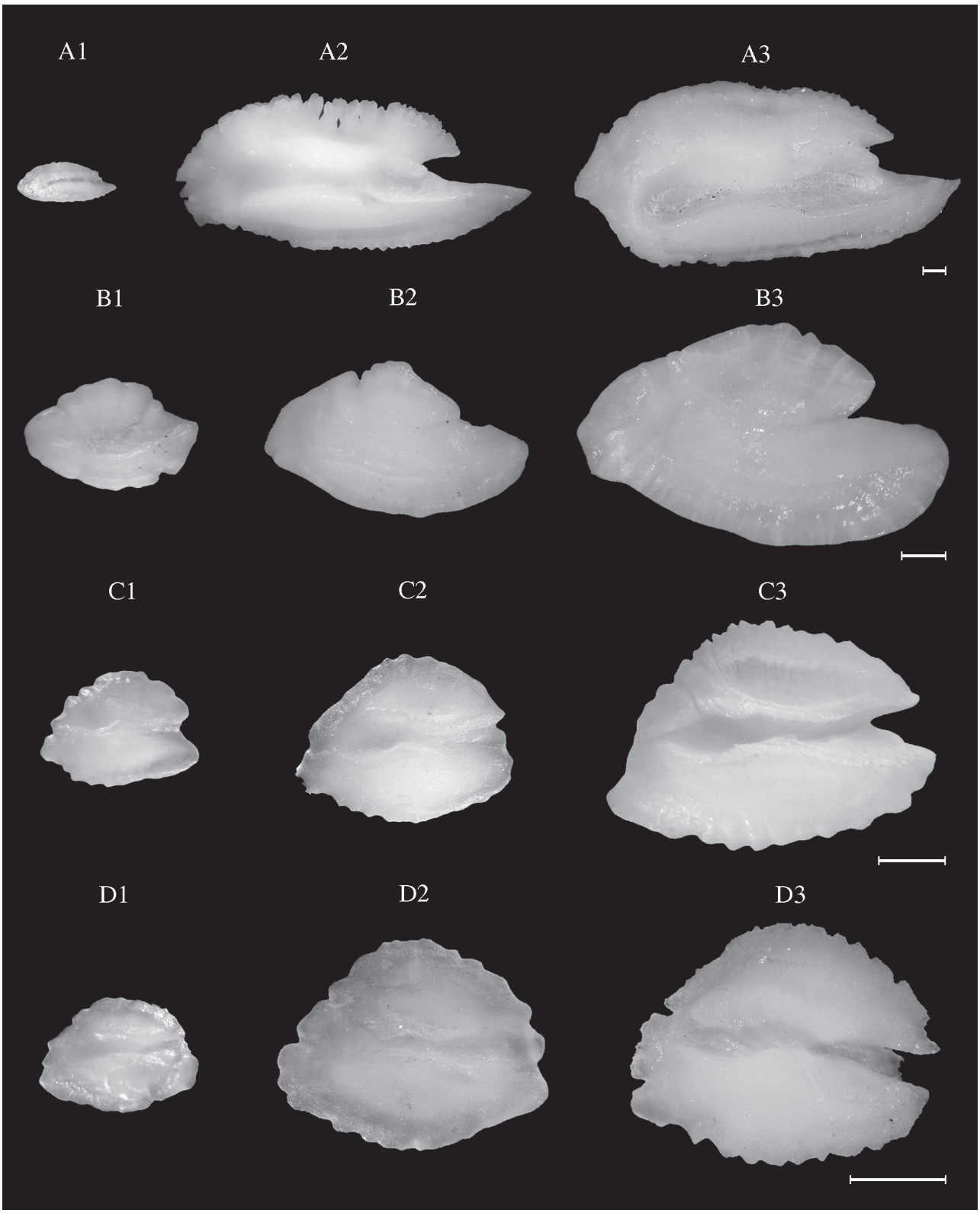

FIG. 43. – *Scorpaena scrofa*. TL: A1, 8.0 cm (WM); A2, 45.8 cm (NEA); A3, 45.0 cm (CEA).
Setarches guentheri (CEA). TL: B1, 7.7 cm; B2, 11.5 cm; B3, 17.5 cm.
Aspitrigla cuculus. TL: C1, 9.5 cm (WM); C2, 16.5 cm (WM); C3, 29.2 cm (NEA).
Chelidonichthys obscurus. TL: D1, 9.0 cm (WM); D2, 19.0 cm (NEA); D3, 24.3 cm (CEA).
Scale bar = 1 mm.

Chelidonichthys gurnardus (Linnaeus, 1758) Family TRIGLIDAE

Shape: approximately oval, posterior and ventral margin sinuate. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: tubular, curved, slightly ascending, wider and slightly or strongly flexed from the middle region, ending close to the posterior-dorsal margin. *Anterior region*: double-peaked; rostrum short, broad, pointed; antirostrum broad, pointed, similar to the rostrum in size; excisura narrow with a deep, acute notch. *Posterior region*: round to oblique to irregular.

OL/TL	OH/OL	Circularity	Rectangularity
1.4-1.8	75.9-85.4	15.0-17.5	0.1

Chelidonichthys lucernus (Linnaeus, 1758) Family TRIGLIDAE

Shape: oval, serrate margins. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: tubular, straight, wider posteriorly, ending close to the posterior-dorsal margin. *Anterior region*: peaked to double-peaked; rostrum short, broad, pointed or blunt; antirostrum broad, pointed, smaller than the rostrum or similar in size; excisura wide with a shallow notch or narrow with a deep, acute notch. *Posterior region*: round to oblique.

OL/TL	OH/OL	Circularity	Rectangularity
1.4-1.8	76.3-84.7	15.4-26.0	0.1

Lepidotrigla cavillone (Lacepède, 1801) Family TRIGLIDAE

Shape: oval or approxmately triangular, dorsal margin sinuate. *Sulcus acusticus*: heterosulcoid, ostial, slightly supramedian. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: tubular, curved, ascending, wider and strongly flexed from the middle region, ending close to the posterior-dorsal margin. *Anterior region*: peaked; rostrum short, broad, round; antirostrum absent or poorly defined; excisura wide with or without a shallow notch. *Posterior region*: round to oblique with a sharp end.

OL/TL	OH/OL	Circularity	Rectangularity
2.8-3.2	62.8-76.7	14.5-15.9	0.1-0.2

Lepidotrigla dieuzeidei Blanc and Hureau, 1973 Family TRIGLIDAE

Shape: elliptic to oval, sinuate margins. *Sulcus acusticus*: heterosulcoid, ostial, slightly supramedian. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: tubular, curved, slightly ascending, wider and slightly flexed from the middle region, ending close to the posterior-dorsal margin. *Anterior region*: peaked; rostrum short, broad, round; antirostrum absent or poorly defined; excisura wide with a shallow notch. *Posterior region*: round to oblique, frequently bifid.

OL/TL	OH/OL	Circularity	Rectangularity
2.7-3.2	67.0-78.2	16.6-20.6	0.1-0.2

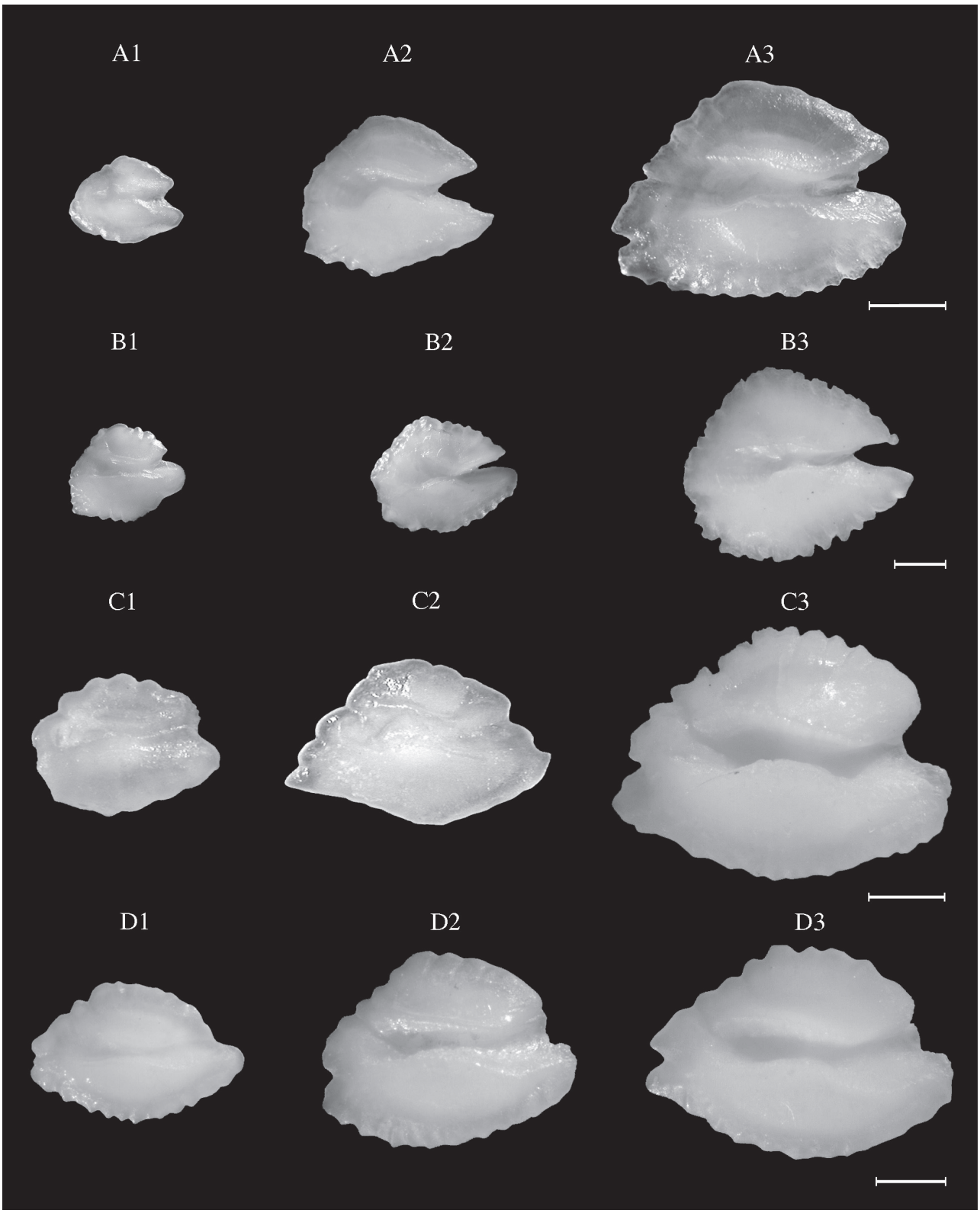

FIG. 44. – *Chelidonichthys gurnardus*. TL: A1, 8.0 cm (WM); A2, 16.3 cm (NEA); A3, 25.0 cm (WM).
Chelidonichthys lucernus. TL: B1, 12.5 cm (WM); B2, 17.0 cm (WM); B3, 32.2 cm (NEA).
Lepidotrigla cavillone. TL: C1, 7.5 cm (WM); C2, 11.5 cm (WM); C3, 15.6 cm (NEA).
Lepidotrigla dieuzeidei (NEA). TL: D1, 9.6 cm; D2, 13.5 cm; D3, 15.9 cm.
Scale bar = 1 mm.

Trigla lyra Linnaeus, 1758 Family TRIGLIDAE

Shape: oval, ventral margin slightly sinuate. *Sulcus acusticus*: heterosulcoid, ostial, slightly supramedian. *Ostium*: funnel-like, as long as the cauda. *Cauda*: tubular, curved, slightly ascending, wider and strongly flexed from the middle region, ending close to the posterior-dorsal margin. *Anterior region*: peaked; rostrum short, broad, round to pointed; antirostrum absent or very small and round; excisura wide with or without a very shallow notch. *Posterior region*: oblique with round or sharp end.

OL/TL	OH/OL	Circularity	Rectangularity
1.5-3.0	69.5-78.2	16.7-19.2	0.1-0.2

Trigloporus lastoviza (Bonnaterre, 1788) Family TRIGLIDAE

Shape: oval to triangular, ventral margin sinuate, dorsal margin irregular. *Sulcus acusticus*: heterosulcoid, ostial, slightly supramedian. *Ostium*: funnel-like, as long as the cauda. *Cauda*: tubular, curved, slightly ascending, strongly flexed from the middle region, ending far from the posterior margin. *Anterior region*: double-peaked to peaked; rostrum short to long, broad, round to pointed; antirostrum smaller than the rostrum, broad, pointed; excisura wide with a shallow or an acute notch. *Posterior region*: oblique to irregular with sharp ends becoming bifid with growth.

OL/TL	OH/OL	Circularity	Rectangularity
2.0-2.6	53.6-72.7	15.6-17.9	0.2-0.3

Peristedion cataphractum (Linnaeus, 1758) Family PERISTEDIIDAE

Shape: elliptic. *Sulcus acusticus*: homosulcoid, ostial, median. *Ostium and cauda*: poorly defined. *Anterior region*: round; rostrum small, broad, round; antirostrum absent; excisura wide without a notch. *Posterior region*: angled.

OL/TL	OH/OL	Circularity	Rectangularity
3.1	60.8	16.6	0.2

Paraliparis leptochirus (Tortonese, 1959) Family LIPARIDIDAE

Shape: discoidal. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, longer than the cauda. *Cauda*: tubular, curved, strongly flexed from the anterior region, ending in the middle region. *Anterior region*: round; rostrum and antirostrum absent; excisura wide without a notch. *Posterior region*: round.

OL/TL	OH/OL	Circularity	Rectangularity
1.9-2.0	78.0-86.4	16.1-16.5	0.1

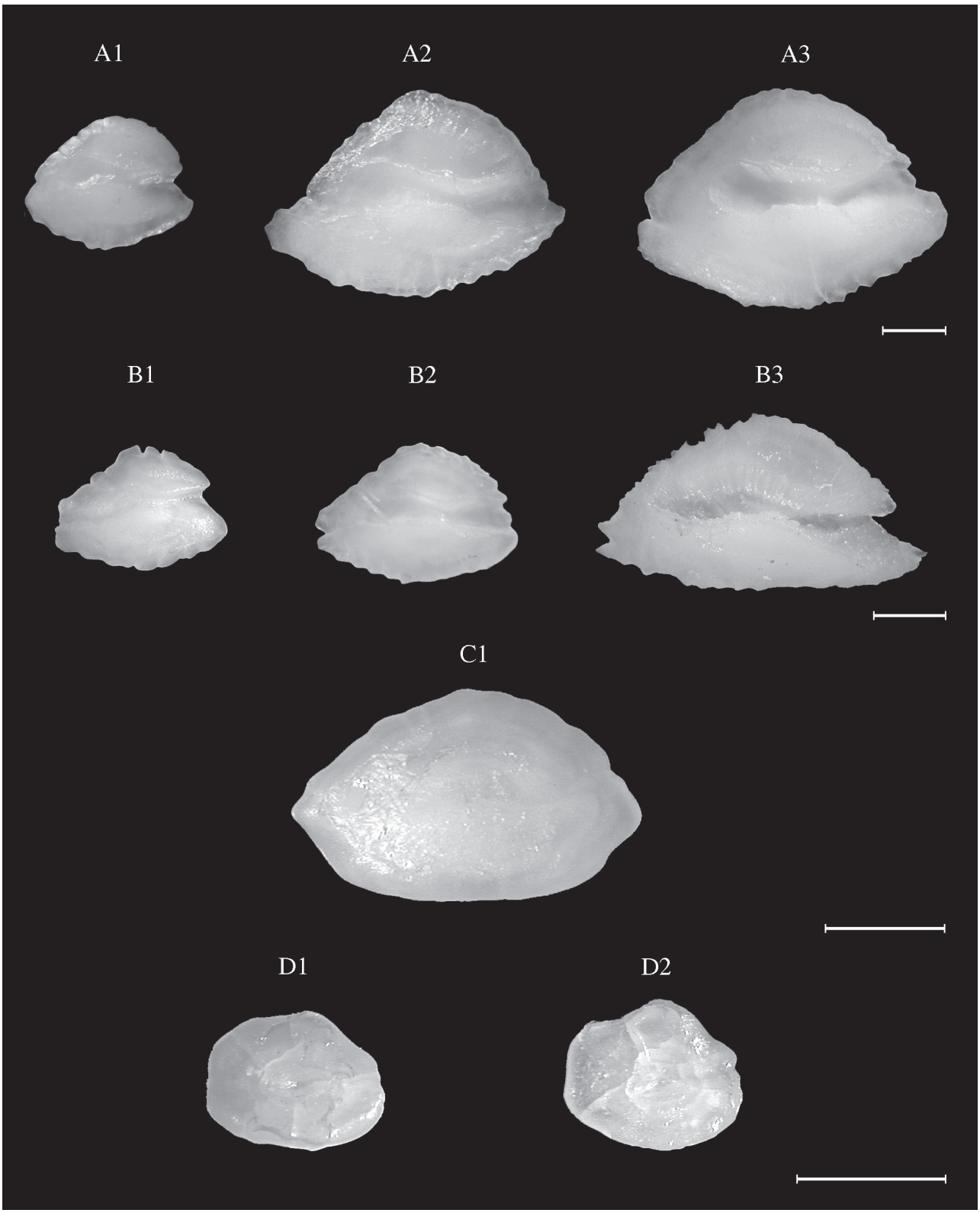

FIG. 45. – *Trigla lyra.* TL: A1, 9.5 cm (WM); A2, 21.0 cm (WM); A3, 33.3 cm (NEA).
Trigloporus lastoviza. TL: B1, 9.0 cm (WM); B2, 12.8 cm (NEA); B3, 23.0 cm (CEA).
Peristedion cataphractum (WM). TL: C1, 9.5 cm.
Paraliparis lectochirus (WM). TL: D1, 5.9 cm; D2, 6.1 cm.
Scale bar = 1 mm.

Order PERCIFORMES

Dicentrarchus labrax (Linnaeus, 1758) Family MORONIDAE

Shape: fusiform to oblong, margins slightly crenated. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: finnel-like, shorter than the cauda. *Cauda*: tubular, curved, strongly flexed posteriorly, ending close to the postero-ventral margin. *Anterior region*: peaked; rostrum short, broad, pointed; antirostrum poorly defined; excisura wide without a notch. *Posterior region*: round to oblique.

OL/TL	OH/OL	Circularity	Rectangularity
2.6-3.9	40.8-45.9	17.7-19.0	0.4

Dicentrarchus punctatus (Bloch, 1792) Family MORONIDAE

Shape: fusiform to oblong, margins slightly crenate to irregular. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: flared, shorter than the cauda. *Cauda*: tubular, curved, strongly flexed posteriorly, ending close to the postero-ventral margin. *Anterior region*: peaked; rostrum short, broad, pointed; antirostrum poorly defined or very small, narrow and sharply pointed; excisura wide with or without an acute notch. *Posterior region*: round.

OL/TL	OH/OL	Circularity	Rectangularity
3.6-4.7	39.9-48.5	18.1-19.0	0.4

Polyprion americanus (Bloch and Schneider, 1801) Family POLYPRIONIDAE

Shape: oblong to fusiform, dorsal and posterior margins dentate to irregular with indentations. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, longer than the cauda. *Cauda*: tubular, curved, strongly to markedly flexed posteriorly, ending close to the posterior-ventral margin. *Anterior region*: peaked; rostrum broad, long, pointed; antirostrum broad, short, slightly pointed; excisura wide with or without a deep, acute notch. *Posterior region*: oblique to irregular.

OL/TL	OH/OL	Circularity	Rectangularity
2.0-2.4	47.9-52.4	18.6-21.6	0.3-0.4

Anthias anthias (Linnaeus, 1758) Family SERRANIDAE

Shape: elliptic, ventral margin sinuate to slightly dentate, dorsal margin irregular. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: tubular, curved, slightly flexed posteriorly, ending close to the posterior margin. *Anterior region*: peaked; rostrum short, broad, pointed; antirostrum absent; excisura wide without a notch. *Posterior region*: angled to oblique-round.

OL/TL	OH/OL	Circularity	Rectangularity
3.4-3.8	51.6-58.3	16.0-20.6	0.3

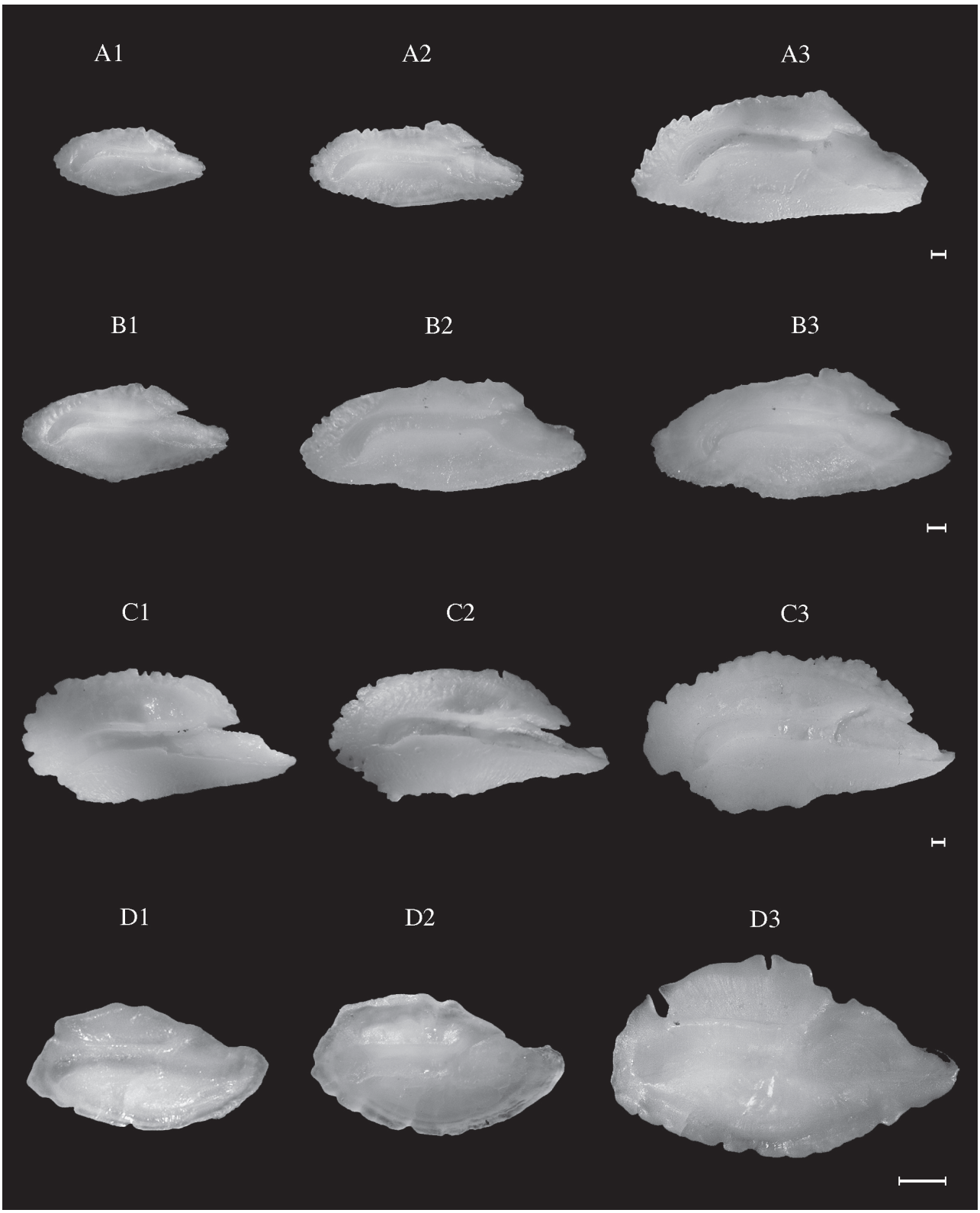

FIG. 46. – *Dicentrarchus labrax*. TL: A1, 24.7 cm (NEA); A2, 45.5 cm (NEA); A3, 72.0 cm (WM).
Dicentrarchus punctatus TL: B1, 22.6 cm (NEA); B2, 41.0 cm (CEA); B3, 43.0 cm (WM).
Polyprion americanus (CEA). TL: C1, 83.0 cm; C2, 90.6 cm; C3, 111.2 cm.
Anthias anthias. TL: D1, 13.0 cm (WM); D2,13.5 cm (CEA); D3,21.2 cm (NEA).
Scale bar = 1 mm.

Cephalopholis taeniops (Valenciennes, 1828) Family SERRANIDAE

Shape: oblong, ventral margin crenate. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: tubular, curved, strongly flexed from the middle region, ending close to the posterior margin. *Anterior region*: peaked; rostrum short, broad, pointed; antirostrum poorly defined; excisura wide without a notch. *Posterior region*: oblique-round to irregular.

OL/TL	OH/OL	Circularity	Rectangularity
4.5	47.2	19.3	0.4

Epinephelus aeneus (Geoffroy Saint-Hilaire, 1817) Family SERRANIDAE

Shape: elliptic, posterior-dorsal margin crenate. *Sulcus acusticus*: heterosulcoid, ostial, slightly supramedian. *Ostium*: funnel-like, as long as the cauda. *Cauda*: tubular, curved, strongly to markedly flexed from the middle region, ending close to the posterior margin. *Anterior region*: peaked; rostrum short to relatively long, broad, pointed; antirostrum short, narrow, pointed; excisura wide with a small, shallow notch. *Posterior region*: round.

OL/TL	OH/OL	Circularity	Rectangularity
3.5	53.6-54.1	16.3-16.7	0.3

Epinephelus caninus (Valenciennes, 1843) Family SERRANIDAE

Shape: elliptic, dorsal margin irregular. *Sulcus acusticus*: heterosulcoid, ostial, supramedian. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: tubular, curved, strongly flexed from the middle region, ending close to the posterior margin. *Anterior region*: peaked; rostrum short, broad, blunt; antirostrum poorly defined; excisura wide without a notch. *Posterior region*: oblique to irregular.

OL/TL	OH/OL	Circularity	Rectangularity
2.7	47.8	19.0	0.4

Epinephelus costae (Steindachner, 1878) Family SERRANIDAE

Shape: oblong to elliptic, ventral margin serrate, posterior-dorsal margin irregular. *Sulcus acusticus*: heterosulcoid, ostial, supramedian. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: tubular, sinuously curved, strongly flexed from the middle region, ending close to the posterior margin. *Anterior region*: peaked; rostrum short, broad, blunt; antirostrum poorly defined; excisura wide without a notch. *Posterior region*: round to oblique, irregular.

OL/TL	OH/OL	Circularity	Rectangularity
2.4-2.7	46.9-49.2	17.8-18.5	0.3-0.4

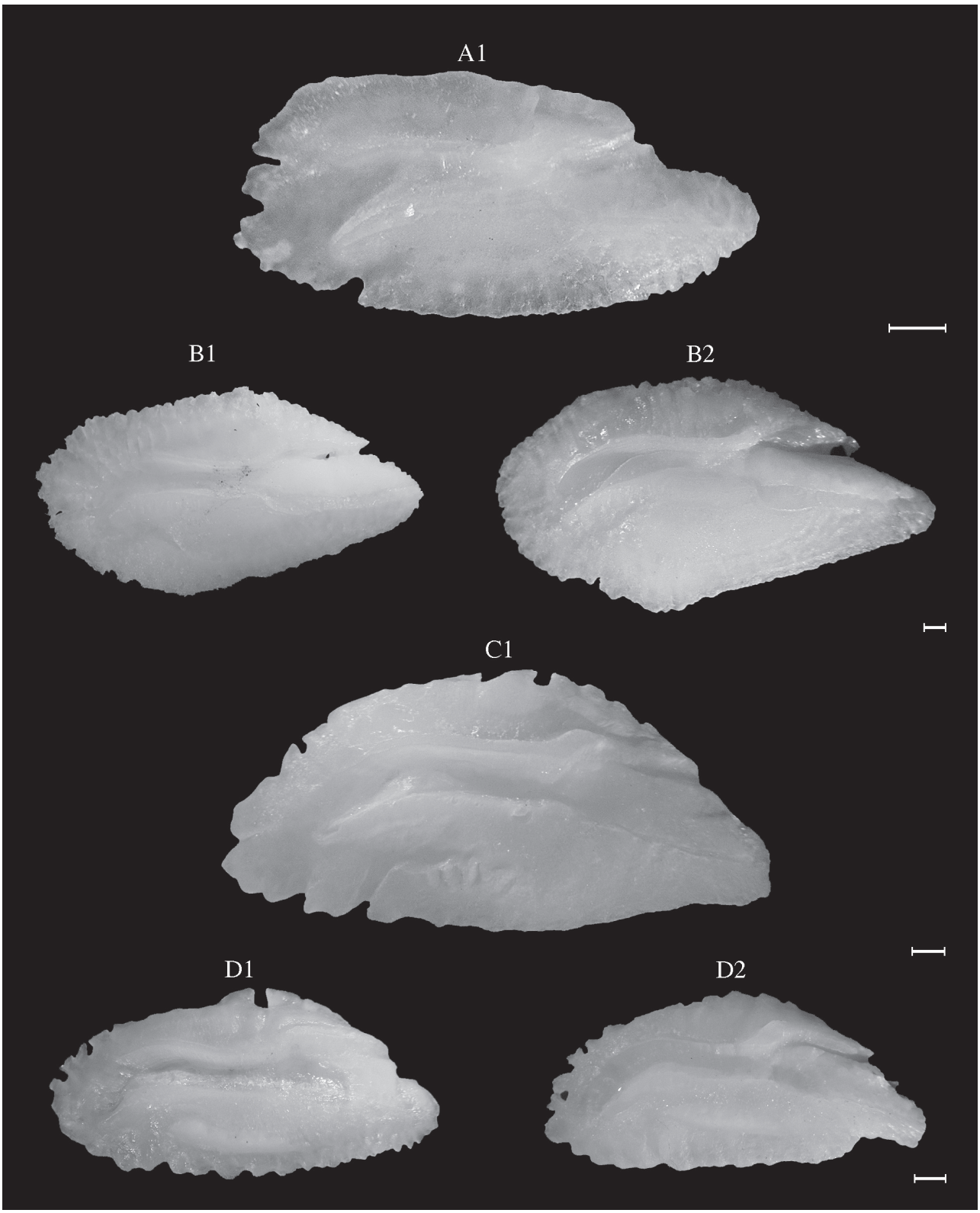

FIG. 47. – *Cephalopholis taeniops* (CEA). TL: A1, 19.8 cm.
Epinephelus aeneus (WM). TL: B1, 48.5 cm; B2, 55.0 cm.
Epinephelus caninus (CEA). TL: C1, 60.4 cm.
Epinephelus costae (CEA). TL: D1, 44.0 cm; D2, 50.3 cm.
Scale bar = 1 mm.

Epinephelus marginatus (Lowe, 1834) Family SERRANIDAE

Shape: elliptic, ventral margin serrate, dorsal margin irregular. *Sulcus acusticus*: heterosulcoid, ostial, supramedian or median. *Ostium*: funnel-like, longer than the cauda. *Cauda*: tubular, sinuously curved, strongly or markedly flexed from the middle region, ending close to the posterior-ventral margin. *Anterior region*: peaked; rostrum short, broad, pointed; antirostrum short, broad, pointed; excisura wide with an acute, shallow notch. *Posterior region*: oblique to irregular.

OL/TL	OH/OL	Circularity	Rectangularity
2.8-2.9	46.6-50.8	19.0-20.1	0.3-0.4

Epinephelus tauvina (Forsskål, 1775) Family SERRANIDAE

Shape: elliptic, ventral margin serrate, dorsal margin crenate. *Sulcus acusticus*: heterosulcoid, ostial, supramedian. *Ostium*: funnel-like, longer than the cauda. *Cauda*: tubular, curved, strongly flexed from the middle region, ending close to the posterior-ventral margin. *Anterior region*: peaked; rostrum long, broad, pointed; antirostrum short, narrow, sharply pointed; excisura wide with an acute, shallow notch. *Posterior region*: oblique to irregular.

OL/TL	OH/OL	Circularity	Rectangularity
2.3	43.2	21.0	0.4

Mycteroperca fusca (Lowe, 1838) Family SERRANIDAE

Shape: oblong, ventral margin serrate, posterior-dorsal margin sinuate. *Sulcus acusticus*: heterosulcoid, ostial, supramedian. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: tubular, curved, strongly flexed from the middle region, ending close to the posterior margin. *Anterior region*: peaked; rostrum short, relatively narrow, pointed; antirostrum absent; excisura wide without a notch. *Posterior region*: oblique to round.

OL/TL	OH/OL	Circularity	Rectangularity
2.0-2.3	39.0-40.1	19.7-20.3	0.4

Mycteroperca rubra (Bloch, 1793) Family SERRANIDAE

Shape: oblong, irregular margins. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: tubular, curved, strongly flexed from the middle region, ending close to the posterior-ventral margin. *Anterior region*: peaked; rostrum short, broad, blunt; antirostrum short, broad, pointed; excisura wide with or without a shallow, round notch. *Posterior region*: oblique to irregular.

OL/TL	OH/OL	Circularity	Rectangularity
2.4	42.8	20.4	0.4

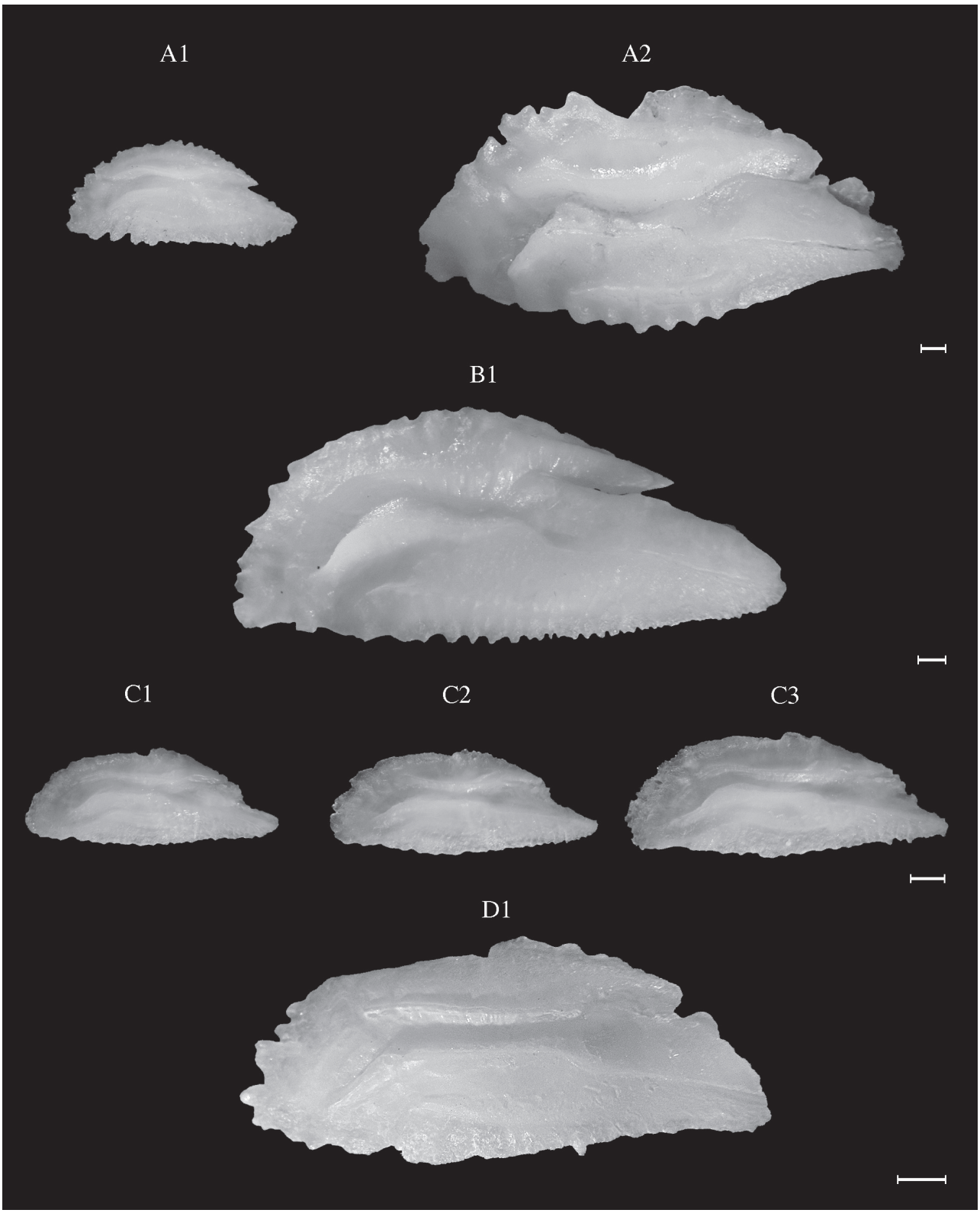

FIG. 48. – *Epinephelus marginatus* (CEA). TL: A1, 31.5 cm; A2, 78.5 cm.
Epinephelus tauvina (CEA). TL: B1, 70.2 cm.
Mycteroperca fusca (CEA). TL: C1, 35.5 cm; C2, 36.0 cm; C3, 40.0 cm.
Mycteroperca rubra (CEA). TL: D1, 44.7 cm.
Scale bar = 1 mm.

Serranus atricauda Günther, 1874 Family SERRANIDAE

Shape: elliptic to fusiform, crenate margins. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: tubular, curved, strongly flexed from the middle region, ending close to the posterior-ventral margin. *Anterior region*: peaked; rostrum short to long, broad, pointed; antirostrum absent or short, broad, round or pointed; excisura very wide with or without a shallow notch. *Posterior region*: oblique to irregular.

OL/TL	OH/OL	Circularity	Rectangularity
2.6-3.3	41.1-44.9	18.5-19.5	0.4

Serranus cabrilla (Linnaeus, 1758) Family SERRANIDAE

Shape: elliptic to fusiform, dorsal margin sinuate to irregular. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: tubular, curved, strongly flexed from the middle region, ending close to the posterior-ventral margin. *Anterior region*: peaked; rostrum short to long, broad, pointed; antirostrum absent or short, broad, round or pointed; excisura wide, with or without a shallow notch. *Posterior region*: oblique**-**round to oblique.

OL/TL	OH/OL	Circularity	Rectangularity
3.4-4.2	39.9-47.1	17.4-21.6	0.4

Serranus hepatus (Linnaeus, 1758) Family SERRANIDAE

Shape: elliptic, sinuate margins. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: tubular, curved, strongly flexed from the middle region, ending close to the posterior-ventral margin. *Anterior region*: peaked; rostrum long, broad, pointed; antirostrum absent or short, broad, round; excisura wide, with a shallow notch. *Posterior region*: round to angled.

OL/TL	OH/OL	Circularity	Rectangularity
4.8-5.0	48.8-53.1	16.9-19.1	0.3

Serranus scriba (Linnaeus, 1758) Family SERRANIDAE

Shape: fusiform, dorsal margin sinuate to irregular. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, shorter or similar to the cauda in size. *Cauda*: tubular, curved, strongly flexed from the posterior region, ending close to the posterior-ventral margin. *Anterior region*: peaked; rostrum short to long, broad to narrow, pointed; antirostrum absent or short, broad, round; excisura wide, with or without a shallow notch. *Posterior region*: round to round-irregular.

OL/TL	OH/OL	Circularity	Rectangularity
2.7-4.4	35.4-42.7	17.6-24.0	0.4-0.5

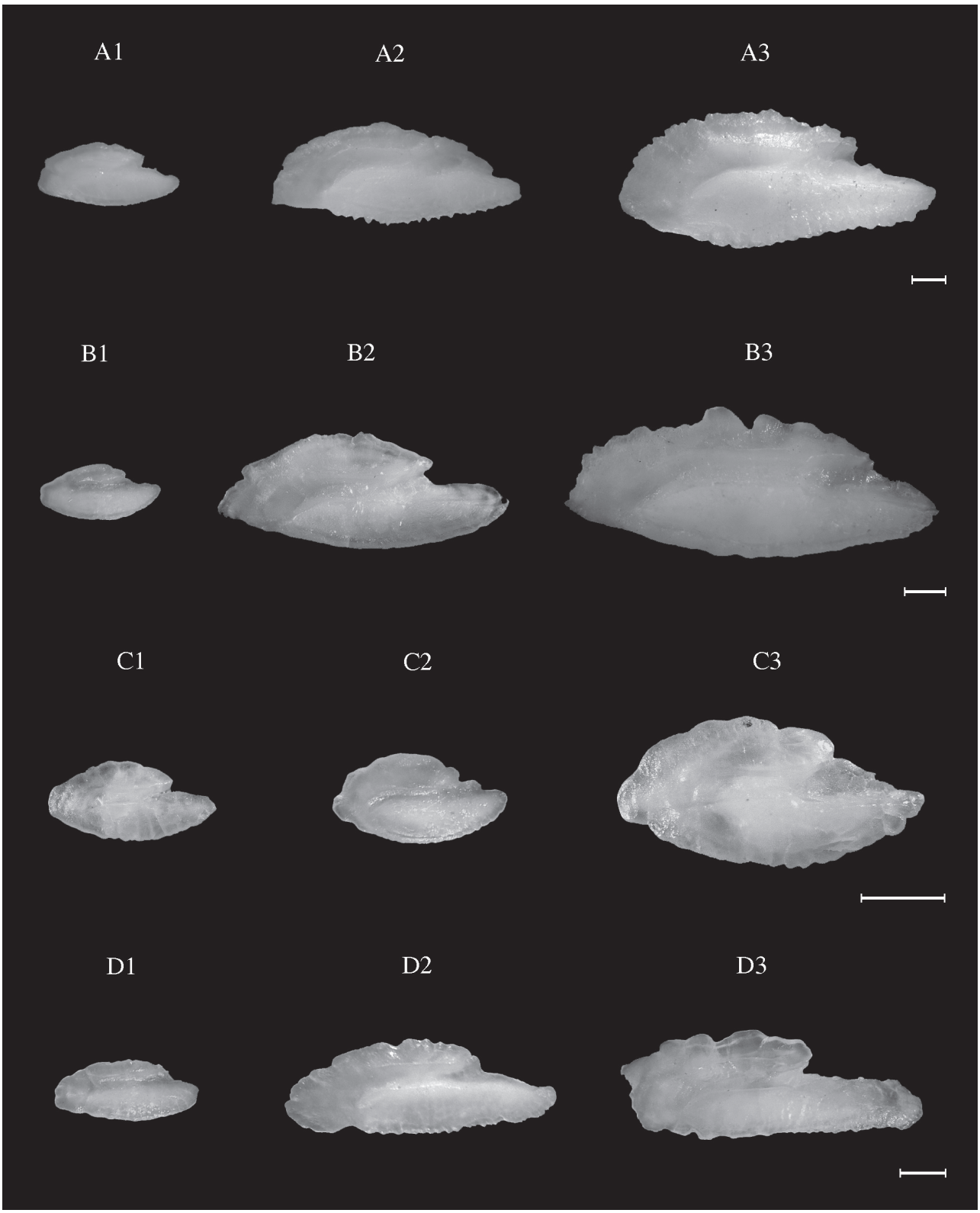

FIG. 49. – *Serranus atricauda* (CEA). TL: A1, 12.1 cm; A2, 25.6 cm; A3, 34.5 cm.
Serranus cabrilla. TL: B1, 7.0 cm (WM); B2, 17.7 cm (NEA); B3, 25.5 cm (CEA).
Serranus hepatus. TL: C1, 5.3 cm (NEA); C2, 8.0 cm (WM); C3, 13.4 cm (NEA).
Serranus scriba. TL: D1, 7.0 cm (WM); D2, 17.5 cm (CEA); D3, 24.0 cm (CEA).
Scale bar = 1 mm.

Callanthias ruber (Rafinesque, 1810) Family CALLANTHIIDAE

Shape: rhomboidal to fusiform, ventral margin crenate in the smaller otoliths. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, slightly curved to the dorsal margin, shorter than or as long as the cauda. *Cauda*: tubular, curved (less noticeably in the smaller specimens), slightly flexed posteriorly, ending close to the posterior margin. *Anterior region*: round; rostrum broad, short, round; antirostrum poorly defined; excisura very wide without a notch. *Posterior region*: angled to oblique.

OL/TL	OH/OL	Circularity	Rectangularity
2.6-3.0	55.5-67.5	14.3-15.5	0.2-0.3

Heteropriacanthus cruentatus (Lacepède, 1801) Family PRIACANTHIDAE

Shape: elliptic, dorsal margin lobed, ventral margin irregular. *Sulcus acusticus*: heterosulcoid, ostial, supramedian. *Ostium*: funnel-like, as long as the cauda or slightly shorter. *Cauda*: tubular, curved, strongly flexed posteriorly, ending very close to the posterior margin. *Anterior region*: peaked; rostrum short, broad, pointed; antirostrum small, broad, pointed; excisura wide with an acute notch. *Posterior region*: round to irregular.

OL/FL	OH/OL	Circularity	Rectangularity
2.7	72.7	19.2	0.2

Epigonus constanciae (Giglioli, 1880) Family EPIGONIDAE

Shape: pentagonal, ventral area more developed. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: bent to discoidal, shorter than the cauda. *Cauda*: tubular, straight, not closed, ending in the posterior margin. *Anterior region*: angled; rostrum very short, broad, slightly pointed, slightly flexed to the dorsal region; antirostrum absent; excisura wide without a notch. *Posterior region*: angled to angled-blunt.

OL/TL	OH/OL	Circularity	Rectangularity
5.1-7.1	74.4-84.0	13.5-14.3	0.1-0.2

Epigonus denticulatus Dieuzeide, 1950 Family EPIGONIDAE

Shape: pentagonal, ventral area slightly more developed and ventral margin sinuate. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like or slightly bent, slightly longer than the cauda. *Cauda*: tubular, straight, wider posteriorly, ending close to the posterior margin. *Anterior region*: peaked; rostrum short, broad, pointed; antirostrum short, broad, pointed; excisura wide with a deep, acute notch. *Posterior region*: angled to round.

OL/TL	OH/OL	Circularity	Rectangularity
4.2-5.1	60.9-66.6	14.8-17.3	0.2

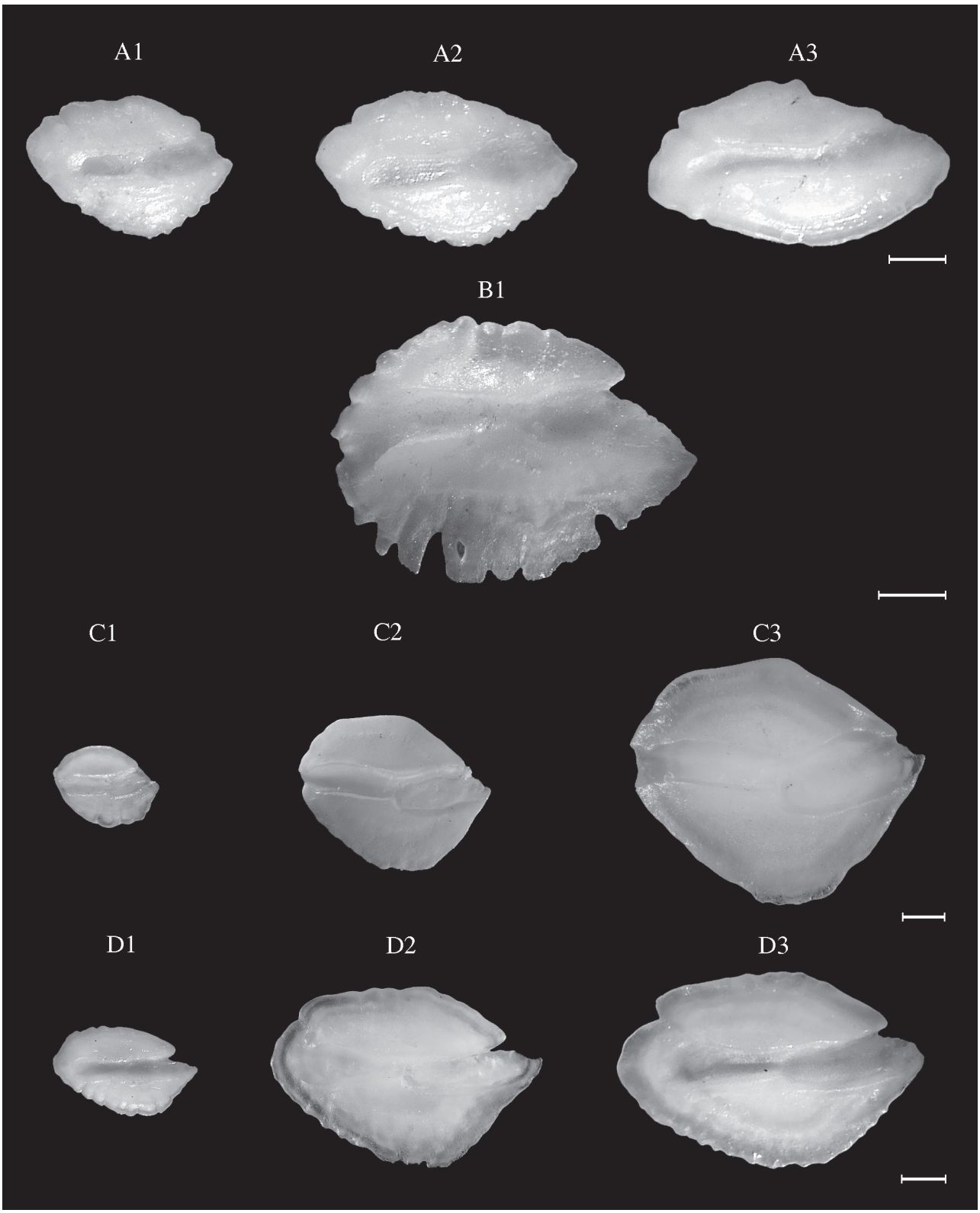

FIG. 50. – *Callanthias ruber* (WM). TL: A1, 14.0 cm; A2, 15.0 cm; A3, 18.0 cm.
Heteropriacanthus cruentatus (CEA). TL: B1, 20.1 cm.
Epigonus constanciae. TL: C1, 3.5 cm (WM); C2, 6.0 cm (CEA); C3, 13.2 cm (NEA).
Epigonus denticulatus. TL: D1, 6.3 cm (WM); D2, 12.5 cm (NEA); D3, 16.5 cm (WM).
Scale bar = 1 mm.

Epigonus telescopus (Risso, 1810) Family EPIGONIDAE

Shape: pentagonal to inverted triangular, ventral area more developed and crenate to serrate. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like to bent, as long as the cauda. *Cauda*: tubular, straight, wider posteriorly, ending close to the posterior margin. *Anterior region*: peaked; rostrum long, broad, pointed, slightly curved to the dorsal region; antirostrum short, broad, pointed or blunt; excisura wide with a deep, acute notch. *Posterior region*: round to pointed.

OL/TL	OH/OL	Circularity	Rectangularity
3.1-4.5	63.6-67.5	14.7-22.3	0.2

Pomatomus saltatrix (Linnaeus, 1766) Family POMATOMIDAE

Shape: rectangular, some deep and irregular indentations mainly in the posterior-ventral margin, anterior-ventral margin dentate. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: tubular, curved, slightly flexed posteriorly, ending very close to the posterior margin. *Anterior region*: peaked; rostrum elongated, broad, blunt, with tip and upper margin slightly serrate; antirostrum poorly developed or short, broad, round or pointed; excisura very wide with or without an acute, shallow notch. *Posterior region*: oblique to irregular.

OL/FL	OH/OL	Circularity	Rectangularity
2.1-2.6	31.0-33.4	23.0-25.5	0.5

Coryphaena hippurus Linnaeus, 1758 Family CORYPHAENIDAE

Shape: approximately hour-glass. *Sulcus acusticus*: heterosulcoid, ostio-caudal, median. *Ostium*: funnel-like, longer than the cauda. *Cauda*: funnel-like, straight. *Anterior region*: double-peaked; rostrum long, broad, blunt to irregular, curved dorsally; antirostrum long, broad, round, shorter than the rostrum; excisura wide with a very deep, acute notch. *Posterior region*: double-peaked; post-rostrum short, broad, round; post-antirostrum short, very broad, slightly flattened and shorter than the post-rostrum; excisura caudalis wide, with a deep, acute notch.

OL/TL	OH/OL	Circularity	Rectangularity
-	67.5	27.6	0.2

Caranx rhonchus Geoffroy Saint-Hilaire, 1817 Family CARANGIDAE

Shape: lanceolated. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: tubular, curved, markedly flexed posteriorly, ending close to the posterior-ventral margin. *Anterior region*: peaked; rostrum long, relatively narrow, pointed; antirostrum short, broad, pointed; excisura wide, with an acute notch. *Posterior region*: round to irregular.

OL/TL	OH/OL	Circularity	Rectangularity
2.5	42.3	23.4	0.4

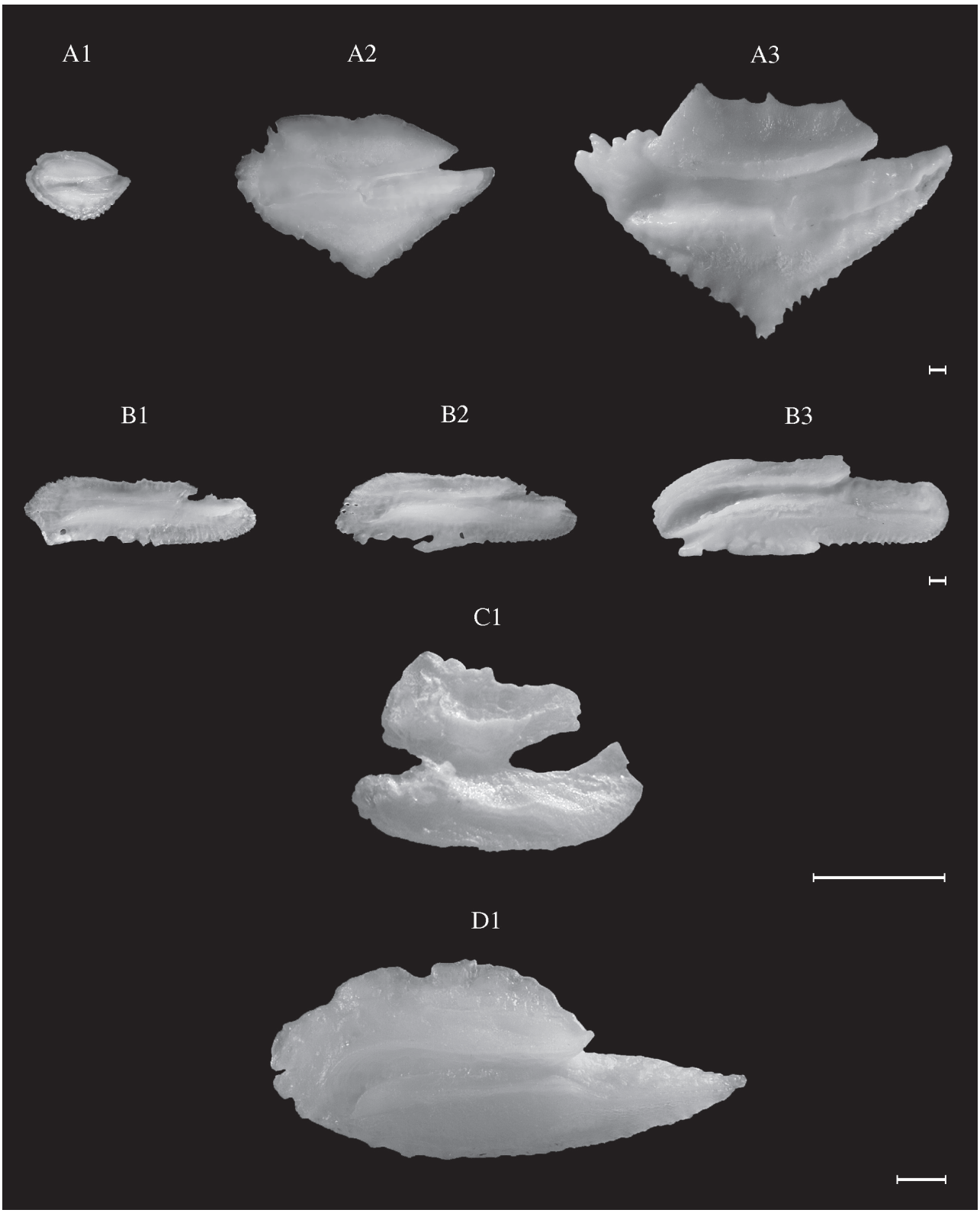

FIG. 51. – *Epigonus telescopus*. TL: A1, 13.0 cm (WM); A2, 37.6 cm (NEA); A3, 69.0 cm (CEA).
Pomatomus saltarix (CEA). TL: B1, 51.0 cm; B2, 67.3 cm; B3, 80.0 cm.
Coryphaena hippurus (WM). TL: C1, no available data.
Caranx rhonchus (NEA). TL: D1, 38.0 cm.
Scale bar = 1 mm.

Lichia amia (Linnaeus, 1758) Family CARANGIDAE

Shape: elliptic to lanceolated, postero-dorsal margin sinuate to irregular. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: tubular, straight, wider posteriorly, ending close to the posterior margin. *Anterior region*: peaked; rostrum long to elongated, narrow, pointed; antirostrum poorly defined or long, narrow, pointed; excisura wide with or without an acute, deep notch. *Posterior region*: oblique to round-irregular.

OL/TL	OH/OL	Circularity	Rectangularity
0.3-1.1	38.6-47.6	18.3-30.4	0.4

Pseudocaranx dentex (Bloch and Schneider, 1801) Family CARANGIDAE

Shape: lanceolated, dorsal margin irregular. *Sulcus acusticus*: heterosulcoid, ostial, median, crista superior developed. *Ostium*: funnel-like, as long as the cauda. *Cauda*: tubular, curved, strongly flexed posteriorly, ending close to the posterior-ventral margin. *Anterior region*: peaked; rostrum elongated, moderately narrow, pointed; antirostrum short or long, narrow, pointed with a sharp tip; excisura wide with an acute, deep notch. *Posterior region*: angled to oblique with a small conspicuous and pointed posterovenral projection.

OL/TL	OH/OL	Circularity	Rectangularity
1.6-1.8	40.3-45.2	22.6-25.7	0.4

Seriola carpenteri Mather, 1971 Family CARANGIDAE

Shape: lanceolated, postero-dorsal margin lobed. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, as long as the cauda. *Cauda*: tubular, curved, wide posteriorly, strongly flexed from the middle region, ending close to the posterior margin. *Anterior region*: peaked; rostrum elongated, narrow, pointed; antirostrum short, narrow, pointed with a sharp tip; excisura wide with an acute, deep notch. *Posterior region*: oblique to irregular.

OL/TL	OH/OL	Circularity	Rectangularity
1.0	32.5	29.0	0.5

Seriola dumerili (Risso, 1810) Family CARANGIDAE

Shape: lancelolated. *Sulcus acusticus*: heterosulcoid, ostial, in the largest otoliths the posterior margin may be eroded causing the sulcus to open posteriorly as in ostio-caudal otoliths, median, crista superior developed. *Ostium*: funnel-like, longer than the cauda. *Cauda*: tubular, curved, strongly flexed posteriorly ending very close to the posterior margin. *Anterior region*: peaked; rostrum elongated, narrow, pointed; antirostrum short to long, narrow, pointed, curved to the dorsal direction in the largest otoliths; excisura wide with a shallow or acute, deep notch. *Posterior region*: in the smallest otoliths: angled. In the largest ones: irregular, post-rostrum long, narrow, irregular; post-antirostrum long, broad, pointed; excisura caudalis wide with a deep, acute notch

OL/TL	OH/OL	Circularity	Rectangularity
0.8-1.4	31.7-39.3	23.9-45.5	0.4-0.5

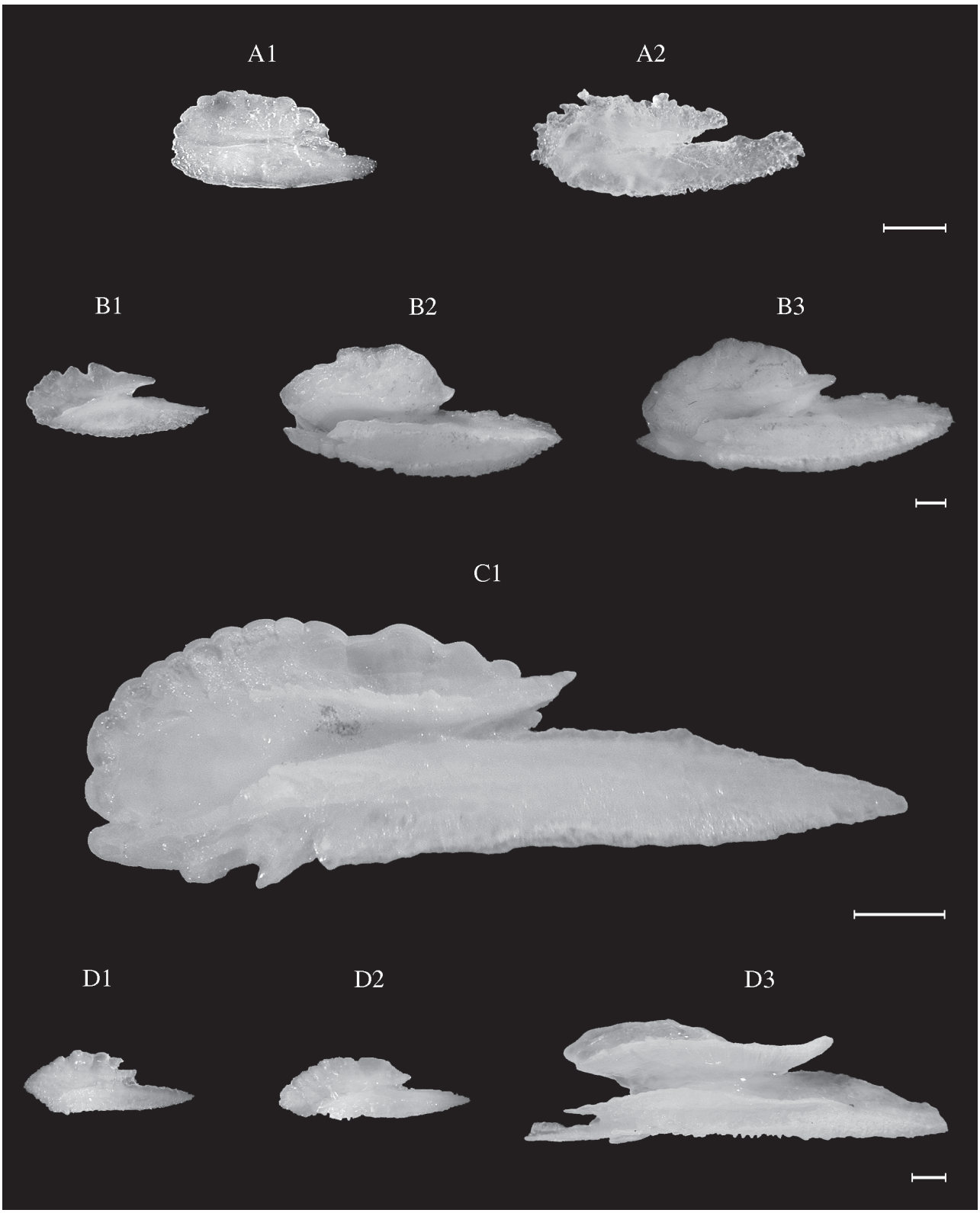

FIG. 52. – *Lichia amia* (WM). TL: A1, 28.5 cm; A2, 143.0 cm.
Pseudocaranx dentex (CEA). TL: B1, 32.0 cm; B2, 57.2 cm; B3, 62.7 cm.
Seriola carpenteri (CEA). TL: C1, 91.6 cm.
Seriola dumerili. TL: D1, 33.5 cm (WM); D2, 37.5 cm (WM); D3, 155.0 cm (CEA).
Scale bar = 1 mm.

Seriola fasciata (Bloch, 1793) Family CARANGIDAE

Shape: lancelolated, postero-dorsal margin slightly lobed. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, as long as the cauda. *Cauda*: tubular, curved, slightly flexed posteriorly, ending close to the posterior margin. *Anterior region*: peaked; rostrum elongated, narrow, pointed; antirostrum short, broad, pointed; excisura wide with a shallow round notch. *Posterior region*: oblique.

OL/TL	OH/OL	Circularity	Rectangularity
1.4	31.6	27.7	0.5

Seriola rivoliana Valenciennes, 1833 Family CARANGIDAE

Shape: lancelolated, postero-ventral margin irregular with deep indentations. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, longer than the cauda. *Cauda*: tubular, curved, slightly flexed from the middle region, ending close to the posterior margin. *Anterior region*: peaked; rostrum elongated, narrow, sharp-pointed; antirostrum short, broad, pointed; excisura wide with an acute notch. *Posterior region*: oblique to irregular.

OL/TL	OH/OL	Circularity	Rectangularity
1.0	29.1	32.8	0.6

Trachinotus ovatus (Linnaeus, 1758) Family CARANGIDAE

Shape: elliptic to slightly fusiform, margins sinuate to dentate. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: tubular, curved, strongly flexed from the middle region, ending close to the posterior-ventral margin. *Anterior region*: peaked; rostrum moderately long, wide, pointed; antirostrum short, broad, round; excisura wide with a shallow notch. *Posterior region*: oblique.

OL/TL	OH/OL	Circularity	Rectangularity
1.8-1.9	42.1-49.0	19.3-20.9	0.3-0.4

Trachurus mediterraneus (Steindachner, 1868) Family CARANGIDAE

Shape: elliptic to lanceolated, dorsal margin sinuate to entire-smooth. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: tubular, straight, ending far from the posterior margin in the smallest otoliths, to curved, strongly flexed posteriorly, ending close to the posterior-ventral margin in the largest ones. *Anterior region*: peaked; rostrum short to long, broad, pointed; antirostrum poorly defined or short, broad, round to blunt; excisura wide with or without a shallow notch. *Posterior region*: round to oblique.

OL/TL	OH/OL	Circularity	Rectangularity
2.7-3.0	47.0-60.6	15.4-18.6	0.3-0.4

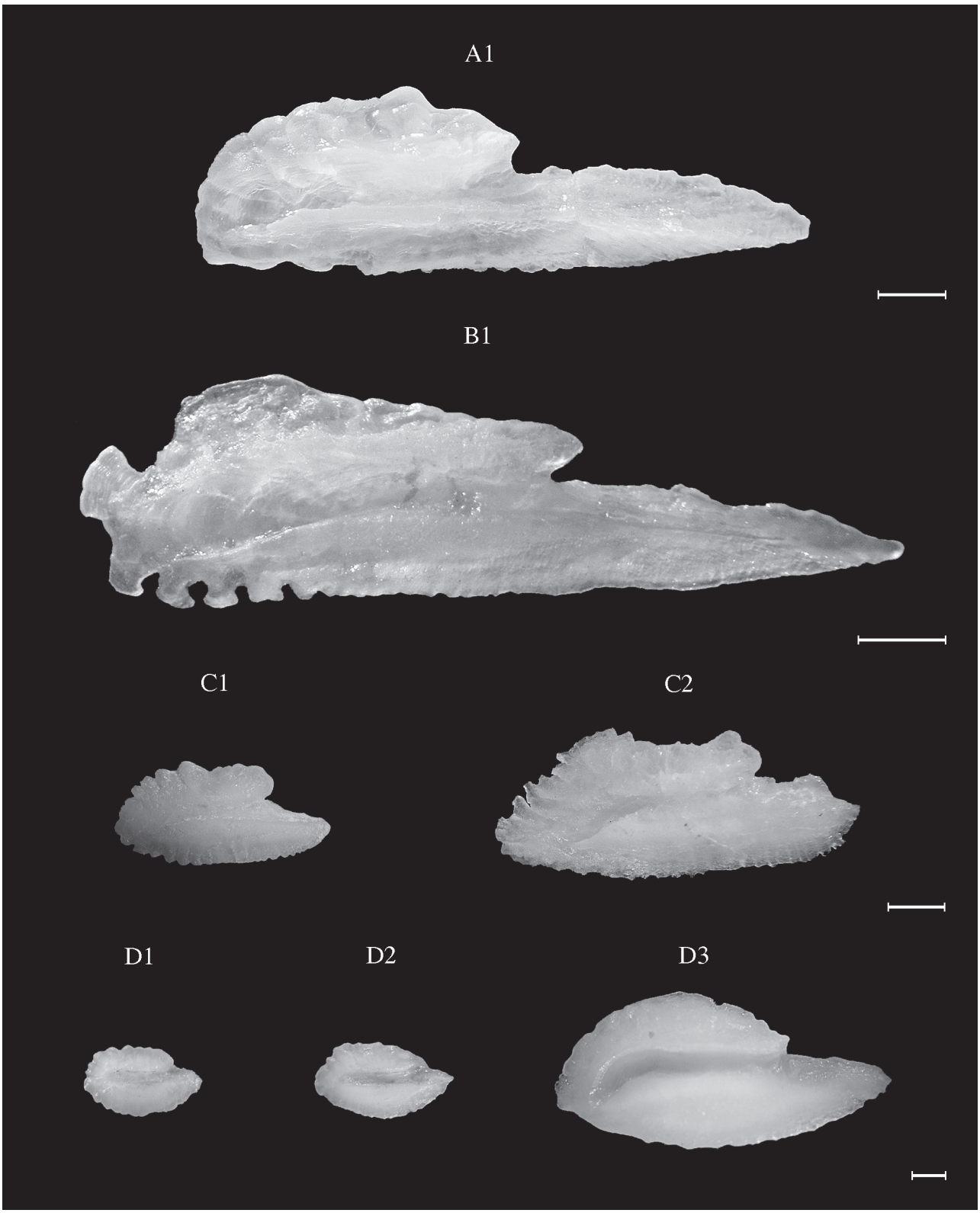

FIG. 53. – *Seriola fasciata* (CEA). TL: A1, 64.7 cm.
Seriola rivoliana (CEA). TL: B1, 94.1 cm.
Trachinotus ovatus (CEA). TL: C1, 19.5 cm; C2, 34.0 cm.
Trachurus mediterraneus (WM). TL: D1, 11.5 cm; D2, 13.5 cm; D3, 36.0 cm.
Scale bar = 1 mm.

Trachurus picturatus (Bowdich, 1825) Family CARANGIDAE

Shape: lanceolated, dorsal margin sinuate to irregular. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: tubular, curved, strongly flexed posteriorly, ending close to the posterior-ventral margin. *Anterior region*: peaked; rostrum long, broad, very pointed; antirostrum short, broad, round; excisura wide with a shallow notch. *Posterior region*: angled to oblique.

OL/TL	OH/OL	Circularity	Rectangularity
2.5-2.8	44.8-47.6	19.8-22.3	0.4

Trachurus trachurus (Linnaeus, 1758) Family CARANGIDAE

Shape: lanceolated, dorsal margin irregular. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: tubular, curved, strongly flexed posteriorly, ending close to the posterior-ventral margin. *Anterior region*: peaked; rostrum long, broad, pointed; antirostrum poorly defined or short, broad, round; excisura wide with a shallow notch. *Posterior region*: angled to round-oblique.

OL/TL	OH/OL	Circularity	Rectangularity
1.9-3.2	47.2-53.0	17.4-22.8	0.3-0.4

Brama brama (Bonnaterre, 1788) Family BRAMIDAE

Shape: lancelolated to approximately trapezoidal, anteriorly asymmetric, dorsal margin lobate. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, as long as the cauda. *Cauda*: elliptic, straight, ending next to the posterior margin. *Anterior region*: peaked; rostrum long to elongated, moderately narrow, pointed; antirostrum long, broad, round to peaked, shorter than the rostrum curved to the dorsal margin; excisura wide with a deep, acute notch. *Posterior region*: oblique.

OL/TL	OH/OL	Circularity	Rectangularity
0.8-1.1	48.5-53.4	23.1-23.5	0.3-0.4

Taractichthys longipinnis (Lowe, 1834) Family BRAMIDAE

Shape: lancelolated, irregular margins. *Sulcus acusticus*: heterosulcoid, ostial, median, the superior and inferior crista are well developed. *Ostium*: funnel-like, as long as the cauda. *Cauda*: elliptic, straight, ending close to the posterior margin. *Anterior region*: peaked; rostrum elongated, moderately narrow, pointed; antirostrum elongated, narrow, shorter than rostrum, cuved to the dorsal margin; excisura wide with a deep, acute notch. *Posterior region*: round to irregular.

OL/TL	OH/OL	Circularity	Rectangularity
0.9	41.7	28.0	0.4

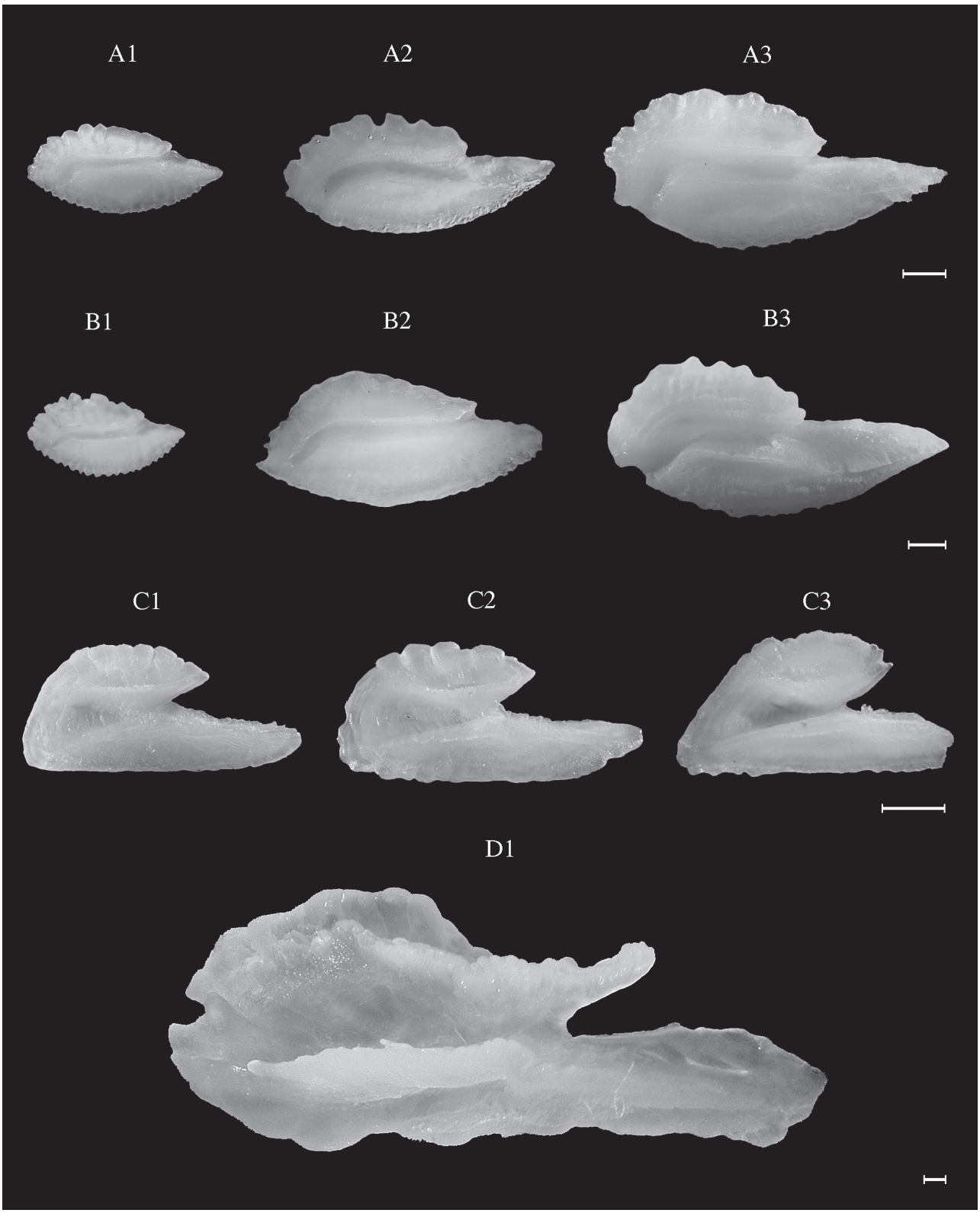

FIG. 54. – *Trachurus picturatus*. TL: A1, 16.0 cm (NEA); A2, 23.0 cm (WM); A3, 31.7 cm (NEA).
Trachurus trachurus. TL: B1, 12.5 cm (CEA); B2, 26.5 cm (WM); B3, 48.7 cm (NEA).
Brama brama. TL: C1, 32.9 cm (NEA); C2, 44.7 cm (NEA); C3, 52.5 cm (CEA).
Taractichthys longipinnis (CEA). TL: D1, 78.3 cm.
Scale bar = 1 mm.

Erythrocles monodi Poll and Cadenat, 1954 Family EMMELICHTHYIDAE

Shape: lancelotaed, ventral margin, dorsal margin irregular. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: tubular, curved, strongly flexed posteriorly, ending close to the posterior-ventral margin. *Anterior region*: peaked; rostrum long, broad, pointed; antirostrum very small, broad, round; excisura wide, with a shallow notch. *Posterior region*: oblique to irregular.

OL/TL	OH/OL	Circularity	Rectangularity
2.5	36.3	24.3	0.5

Parapristipoma octolineatum (Valenciennes, 1833) Family HAEMULIDAE

Shape: elliptic. *Sulcus acusticus*: heterosulcoid, ostial, supramedian. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: tubular, curved, markedly flexed posteriorly, ending in the posterior-ventral region. *Anterior region*: peaked; rostrum short, very broad, round; antirostrum absent; excisura wide, without a notch. *Posterior region*: oblique.

OL/TL	OH/OL	Circularity	Rectangularity
2.9-3.5	46.7-53.0	16.3-17.1	0.3-0.4

Plectorinchus mediterraneus (Guichenot, 1850) Family HAEMULIDAE

Shape: elliptic, dorsal margin dentate to crenate. *Sulcus acusticus*: heterosulcoid, ostial, median or supramedian. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: tubular, curved, markedly flexed posteriorly, ending in the posterior-ventral region. *Anterior region*: peaked; rostrum short, very broad, round; antirostrum short, narrow, sharply pointed; excisura wide with an acute, shallow notch. *Posterior region*: angled to oblique.

OL/TL	OH/OL	Circularity	Rectangularity
3.5-4.0	53.3-55.7	16.4-19.0	0.3

Pomadasys incisus (Bowdich, 1825) Family HAEMULIDAE

Shape: oval, ventral area very developed. *Sulcus acusticus*: heterosulcoid, ostial, supramedian. *Ostium*: rectangular, shorter than the cauda. *Cauda*: tubular, curved, strongly flexed posteriorly, ending in the posterior-ventral region. *Anterior region*: round to oblique; rostrum short, broad, flattenned; antirostrum absent; excisura very wide, without a notch. *Posterior region*: round.

OL/TL	OH/OL	Circularity	Rectangularity
4.1-4.9	65.6-73.0	13.7-15.0	0.2

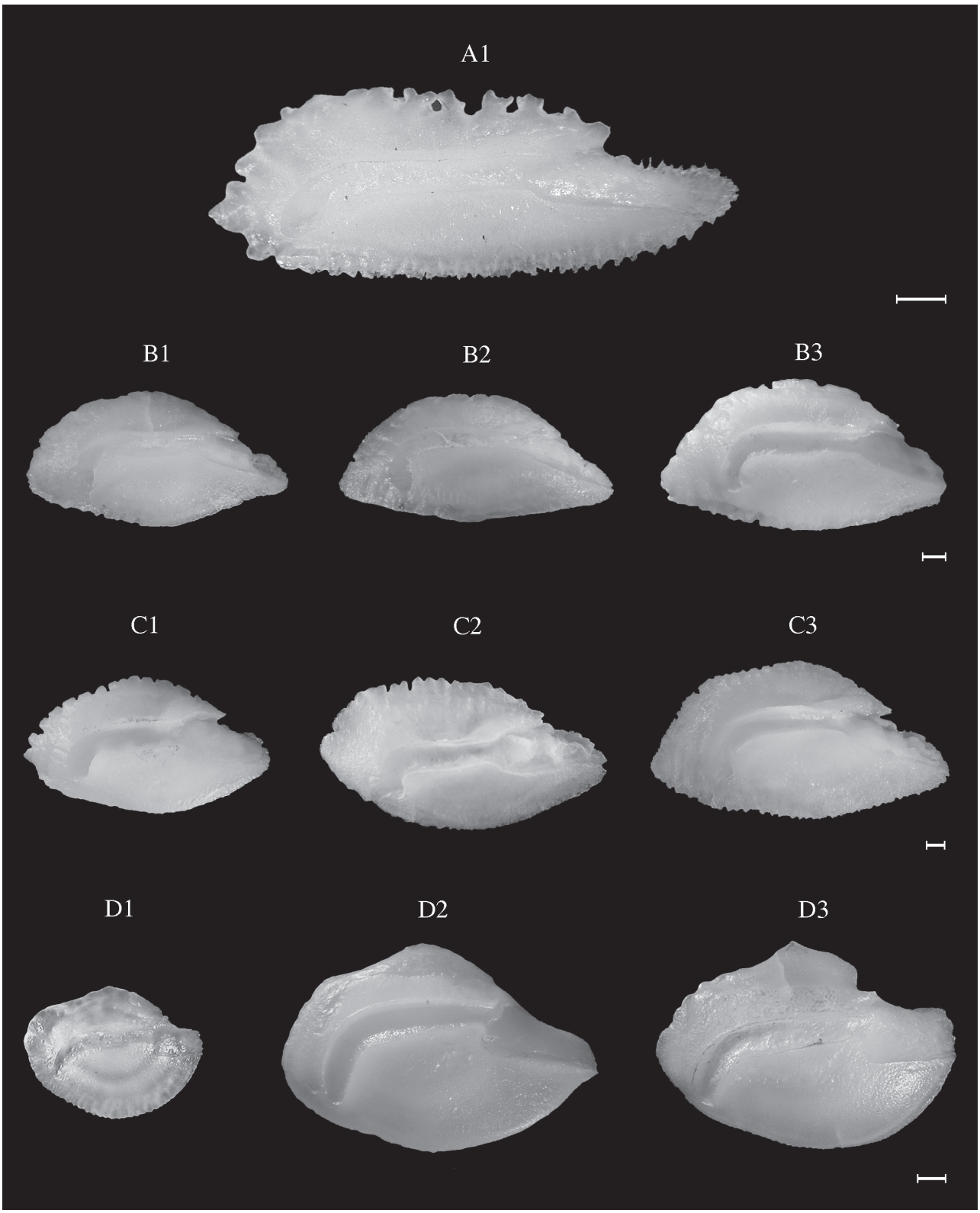

FIG. 55. – *Erythrocles monodi* (CEA). TL: A1, 41.2 cm.
Parapristipoma octolineatum (CEA). TL: B1, 30.7 cm; B2, 32.5 cm; B3, 39.9 cm.
Plectorinchus mediterraneus. TL: C1, 34.0 cm (CEA); C2, 38.0 cm (NEA); C3, 38.5 cm (CEA).
Pomadasys incisus. TL: D1, 14.0 cm (WM); D2, 21.6 cm (CEA); D3, 24.8 cm (CEA).
Scale bar = 1 mm.

Pomadasys perotaei (Cuvier, 1830) Family HAEMULIDAE

Shape: oval, ventral area very developed. *Sulcus acusticus*: heterosulcoid, ostial, supramedian. *Ostium*: rectangular, shorter than the cauda. *Cauda*: tubular, curved, curled from the medial region, ending close to the mid-ventral margin. *Anterior region*: round to oblique; rostrum broad, short, flattened; antirostrum absent; excisura narrow, without a notch. *Posterior region*: round to oblique.

OL/TL	OH/OL	Circularity	Rectangularity
5.0	78.3	13.9	0.1

Boops boops (Linnaeus, 1758) Family SPARIDAE

Shape: elliptic, dorsal margin irregular with a short, wide protuberance in the middle. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: tubular, curved, strongly or markedly flexed posteriorly, ending close to the posterior-ventral margin. *Anterior region*: angled to peaked; rostrum broad, long, slightly pointed; antirostrum poorly developed or very small, narrow, pointed; excisura wide without a notch or with a shallow notch. *Posterior region*: round.

OL/TL	OH/OL	Circularity	Rectangularity
3.2-4.5	44.6-63.7	14.9-16.47	0.2-0.4

Dentex angolensis Poll and Maul, 1953 Family SPARIDAE

Shape: approximately rhomboidal, posterior and dorsal margin dentate. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: tubular, curved, slightly flexed posteriorly, ending close to the posterior-ventral margin. *Anterior region*: angled; rostrum broad, very short, round; antirostrum absent; excisura wide without a notch. *Posterior region*: angled.

OL/TL	OH/OL	Circularity	Rectangularity
4.1	71.2	18.7	0.2

Dentex canariensis Steindachner, 1881 Family SPARIDAE

Shape: elliptic. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, shorther than the cauda. *Cauda*: tubular, curved, strongly flexed from the middle region, ending close to the posterior-ventral margin. *Anterior region*: peaked to angled; rostrum long to short, broad, pointed; antirostrum poorly developed or very small, broad, round; excisura wide with or without a shallow notch. *Posterior region*: oblique.

OL/TL	OH/OL	Circularity	Rectangularity
2.8-2.9	55.6-55.8	16.2-17.3	0.3

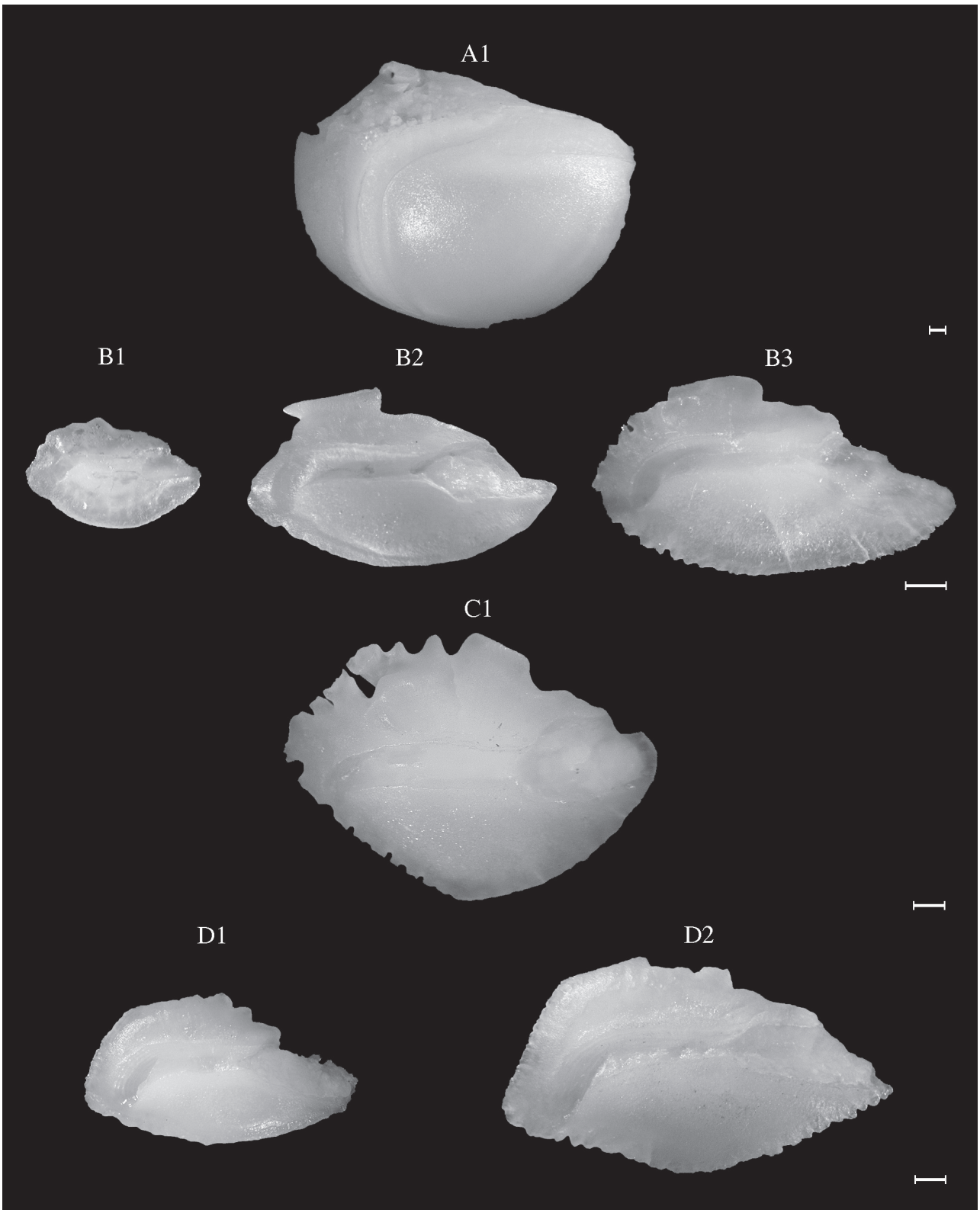

FIG. 56. – *Pomadasys perotaei* (CEA). TL: A1, 40.4 cm.
Boops boops. TL: B1, 13.5 cm (WM); B2, 23.6 cm (NEA); B3, 31.2 cm (CEA).
Dentex angolensis (CEA). TL: C1, 28.8 cm.
Dentex canariensis (CEA). TL: D1, 30.0 cm; D2, 42.5 cm.
Scale bar = 1 mm.

Dentex dentex (Linnaeus, 1758) Family SPARIDAE

Shape: elliptic to oval, margins crenate. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: tubular, curved, slightly to strongly flexed from the middle region, ending close to the posterior-ventral margin. *Anterior region*: angled to peaked; rostrum broad, short, pointed to round; antirostrum poorly defined; excisura wide without a notch. *Posterior region*: oblique or round.

OL/TL	OH/OL	Circularity	Rectangularity
2.0-3.8	55.7-61.7	20.7-26.0	0.2-0.3

Dentex gibbosus (Rafinesque, 1810) Family SPARIDAE

Shape: elliptic, margins serrated to irregular. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: tubular, curved, strongly flexed from the middle region, ending close to the posterior-ventral margin. *Anterior region*: peaked; rostrum short, broad, pointed; antirostrum poorly defined or small, broad and blunt; excisura wide with or without an acute notch. *Posterior region*: oblique.

OL/TL	OH/OL	Circularity	Rectangularity
3.0-3.1	53.6-56.8	16.8-17.4	0.3

Dentex macrophthalmus (Bloch, 1791) Family SPARIDAE

Shape: pentagonal, dorsal margin sinuate to irregular with deep indentations. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: tubular, curved, slightly flexed posteriorly, ending close to the posterior margin. *Anterior region*: angled; rostrum short, broad, pointed, tip slightly flexed to the dorsal region; antirostrum very small, broad, round; excisura wide with or without a shallow notch. *Posterior region*: angled.

OL/TL	OH/OL	Circularity	Rectangularity
4.4-6.8	71.4-77.5	14.2-18.5	0.1-0.2

Dentex maroccanus Valenciennes, 1830 Family SPARIDAE

Shape: pentagonal, dorsal margins dentate to irregular. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: tubular, curved, strongly flexed posteriorly, ending close to the posterior margin. *Anterior region*: angled; rostrum short, broad, pointed, tip slightly flexed to the dorsal region; antirostrum very small, broad, blunt; excisura wide with or without a shallow notch. *Posterior region*: angled.

OL/TL	OH/OL	Circularity	Rectangularity
4.3-4.7	70.7-77.3	14.3-18.7	0.1-0.2

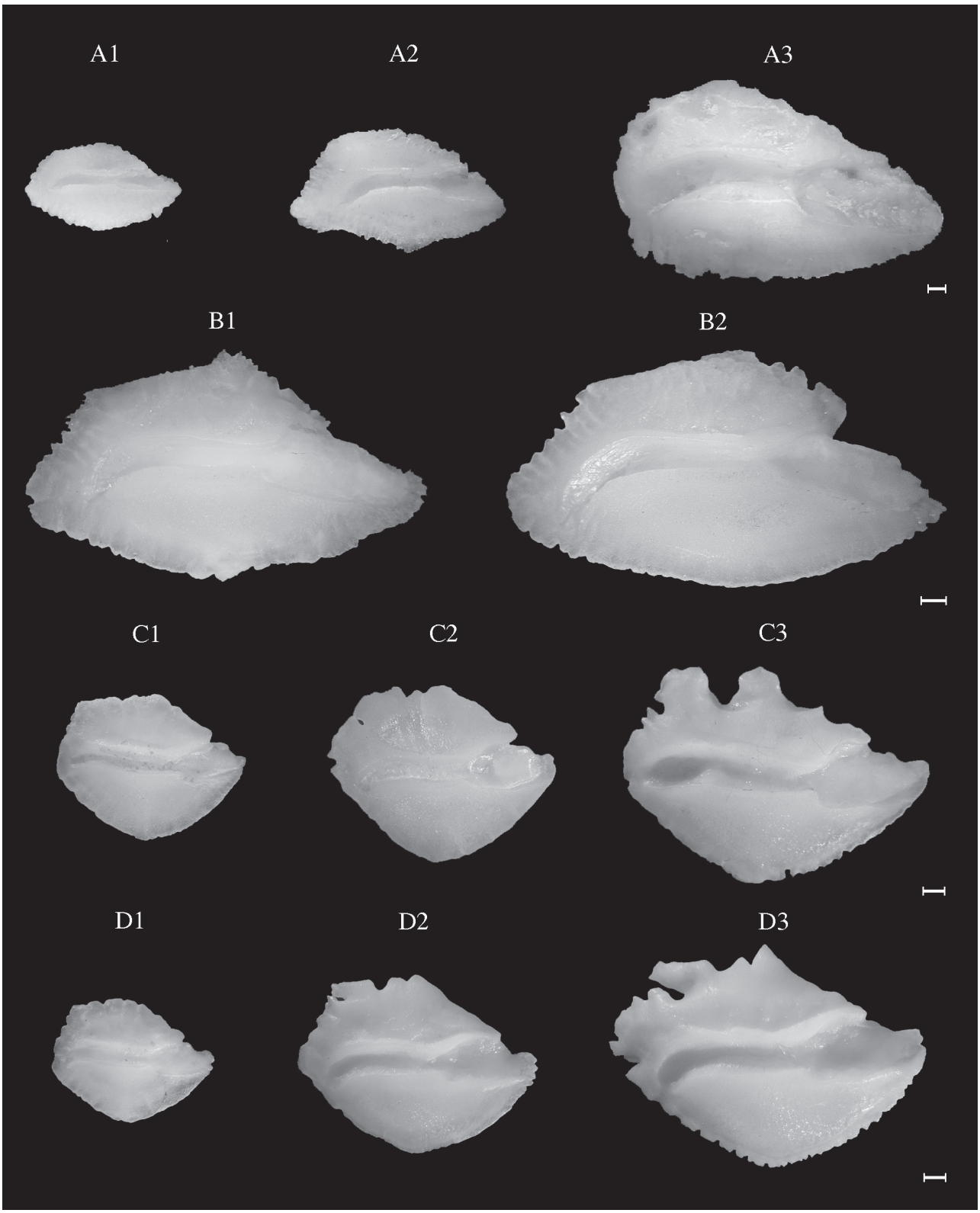

FIG. 57. – *Dentex dentex* (WM). TL: A1, 22.5 cm; A2, 36.5 cm; A3, 81.0 cm.
Dentex gibbosus (CEA). TL: B1, 47.8 cm; B2, 52.0 cm.
Dentex macrophthalmus. TL: C1, 13.4 cm (CEA); C2, 24.1 cm (NEA); C3, 30.0 cm (CEA).
Dentex maroccanus (CEA). TL: D1, 14.9 cm; D2, 23.1 cm; D3, 28.5 cm.
Scale bar = 1 mm.

Diplodus annularis (Linnaeus, 1758) Family SPARIDAE

Shape: pentagonal to oval. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: tubular, curved, strongly flexed from the middle region, ending close to the posterior-ventral margin. *Anterior region*: angled to oblique; rostrum short, broad, blunt; antirostrum poorly defined; excisura wide without a notch. *Posterior region*: round to angled.

OL/TL	OH/OL	Circularity	Rectangularity
1.8-4.0	58.7-68.2	14.1-15.7	0.2

Diplodus bellottii (Steindachner, 1882) Family SPARIDAE

Shape: pentagonal to elliptic, with ventral margin sinuate. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: tubular, curved, strongly flexed from the middle region, ending close to the posterior-ventral margin. *Anterior region*: angled; rostrum short, broad, blunt to pointed; antirostrum poorly defined or small, narrow, pointed; excisura wide with or without an acute notch. *Posterior region*: angled to oblique.

OL/TL	OH/OL	Circularity	Rectangularity
3.4-3.7	56.2-67.5	14.7-16.2	0.2-0.3

Diplodus cervinus (Lowe, 1838) Family SPARIDAE

Shape: elliptic, with margins crenate. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: tubular, curved, strongly flexed from the middle region, ending close to the posterior-ventral margin. *Anterior region*: angled; rostrum short, broad, blunt to pointed; antirostrum poorly defined; excisura wide without a notch. *Posterior region*: round to oblique.

OL/TL	OH/OL	Circularity	Rectangularity
2.7-4.0	51.7-56.8	15.7-23.1	0.3

Diplodus puntazzo (Cetti, 1777) Family SPARIDAE

Shape: elliptic, margins sinuate to irregular. *Sulcus acusticus*: heterosulcoid, ostial. median. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: tubular, curved, strongly flexed from the middle region, ending close to the posterior-ventral margin. *Anterior region*: angled to irregular; rostrum short, broad, pointed to blunt; antirostrum poorly defined or small, broad, round; excisura wide without a notch. *Posterior region*: oblique.

OL/TL	OH/OL	Circularity	Rectangularity
2.1-5.4	56.0-64.0	15.0-16.7	0.2-0.3

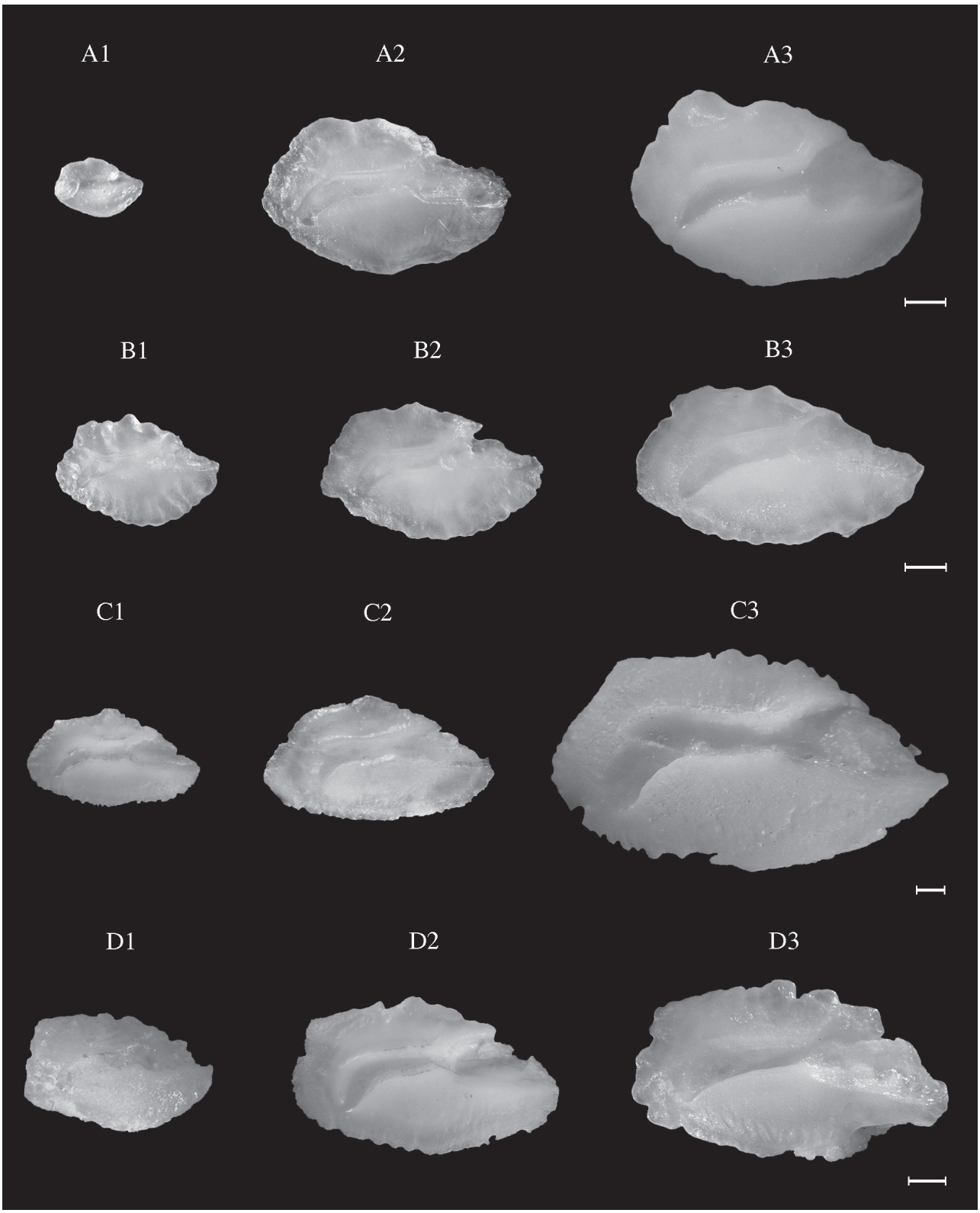

FIG. 58. – *Diplodus annularis*. TL: A1, 5.5 cm (WM); A2, 14.7 cm (NEA); A3, 20,0 cm (CEA).
Diplodus bellottii (NEA). TL: B1, 10.2 cm; B2, 14.5 cm; B3, 19.6 cm.
Diplodus cervinus. TL: C1, 14.2 cm (CEA); C2, 28.0 cm (WM); C3, 50.5 cm (CEA).
Diplodus puntazzo. TL: D1, 10.0 cm (WM); D2, 30.1 cm (CEA); D3, 39.7 cm (NEA).
Scale bar = 1 mm.

Diplodus sargus (Linnaeus, 1758) Family SPARIDAE

Shape: elliptic to oblong, with a conspicuous spike in the middle of dorsal margin delimiting two shallow concavities. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, shorter than or as long as the cauda. *Cauda*: tubular, curved, markedly flexed posteriorly, ending close to the posterior-ventral margin. *Anterior region*: angled; rostrum short, broad, pointed; antirostrum absent or poorly developed; excisura wide without a notch. *Posterior region*: oblique.

OL/TL	OH/OL	Circularity	Rectangularity
2.8-4.2	45.5-58.3	15.4-17.3	0.3-0.4

Diplodus vulgaris (Geoffroy St. Hilaire, 1817) Family SPARIDAE

Shape: approximately pentagonal to elliptic, with ventral margin crenate. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: tubular, curved, strongly flexed psteriorly or from the middle region, ending close to the posterior-ventral margin. *Anterior region*: angled to peaked; rostrum short, broad, pointed; antirostrum poorly developed or small, broad, round; excisura wide with or without a shallow notch. *Posterior region*: oblique or round.

OL/TL	OH/OL	Circularity	Rectangularity
2.9-4.8	49.7-66.9	14.8-17.8	0.2-0.3

Lithognathus mormyrus (Linnaeus, 1758) Family SPARIDAE

Shape: elliptic to oblong. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: tubular, curved, markedly flexed posteriorly, ending very close to the posterior-ventral region. *Anterior region*: angled to round-angled; rostrum short, broad, pointed; antirostrum poorly defined or very small, broad, round; excisura wide with or without a shallow notch. *Posterior region*: oblique to irregular with a pointed end.

OL/TL	OH/OL	Circularity	Rectangularity
2.5-4.5	44.4-60.7	15.2-19.3	0.2-0.4

Oblada melanura (Linnaeus, 1758) Family SPARIDAE

Shape: approximately pentagonal to elliptic, with sinuate margins. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, as long as the cauda. *Cauda*: tubular, curved, strongly flexed form the middle region, ending very close to the posterior-ventral margin. *Anterior region*: angled to peaked; rostrum short, broad, pointed; antirostrum poorly defined or small, narrow, pointed; excisura wide with or without an acute notch. *Posterior region*: round to oblique.

OL/TL	OH/OL	Circularity	Rectangularity
3.0-4.7	50.2-63.3	15.4-17.4	0.2-0.3

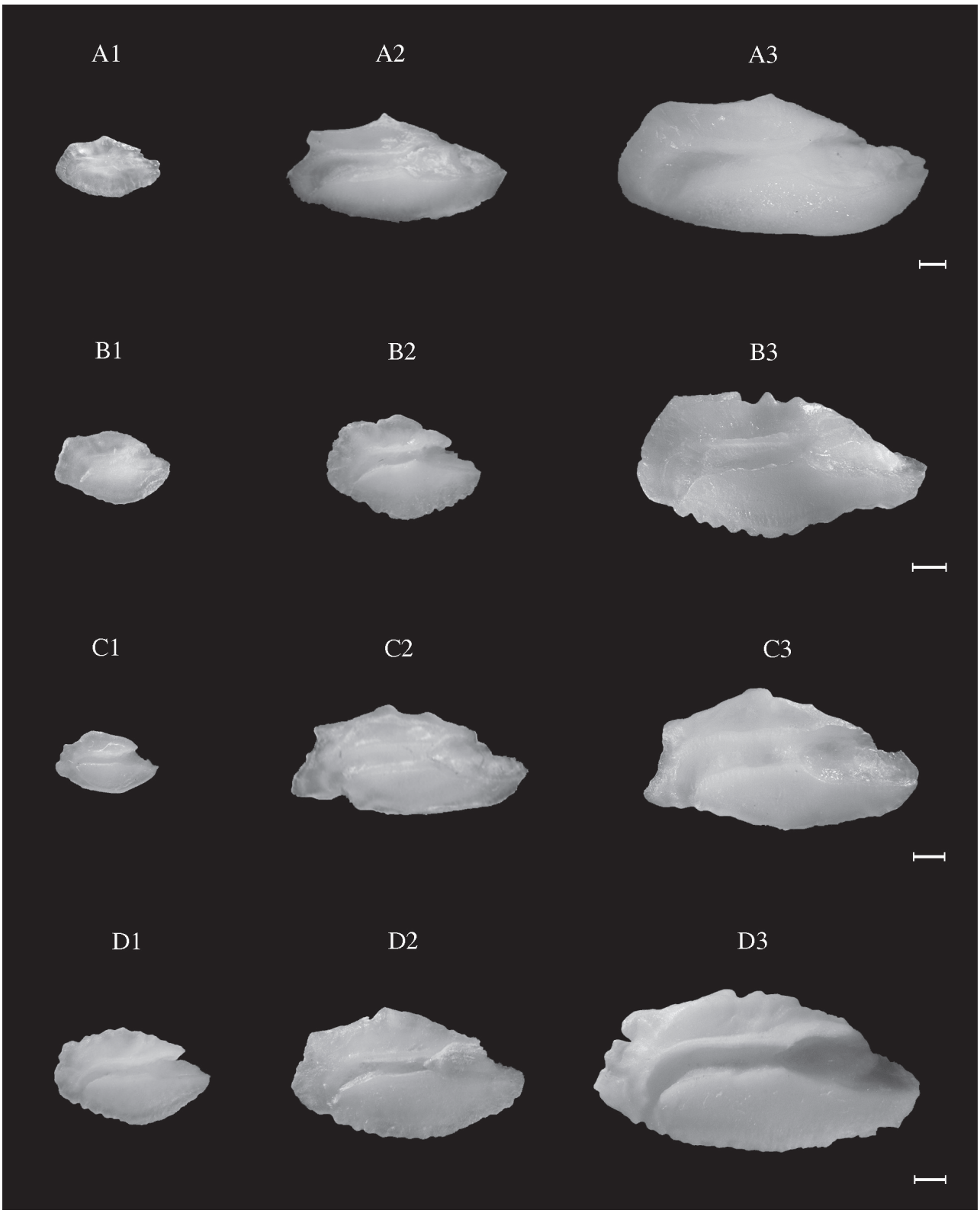

FIG. 59. – *Diplodus sargus*. TL: A1, 9.9 cm (NEA); A2, 28.0 cm (WM); A3, 40.0 cm (CEA).
Diplodus vulgaris. TL: B1, 8.5 cm (WM); B2, 15.0 cm (CEA); B3, 25.5 cm (NEA).
Lithognathus mormyrus. TL: C1, 7.0 cm (CEA); C2, 24.0 cm (WM); C3, 32.9 cm (NEA).
Oblada melanura (CEA). TL: D1, 10.5 cm; D2, 20.0 cm; D3, 34.0 cm.
Scale bar = 1 mm.

Pagellus acarne (Risso, 1827) Family SPARIDAE

Shape: pentagonal to elliptic, margins crenate to irregular. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: tubular, curved, slightly flexed posteriorly to strongly flexed from the middle region, ending very close to the posterior-ventral margin. *Anterior region*: angled to peaked; rostrum short to long, broad, pointed; antirostrum poorly defined or small, broad, round or pointed; excisura wide with or without a shallow, acute notch. *Posterior region*: angled to oblique.

OL/TL	OH/OL	Circularity	Rectangularity
3.7-4.2	46.9-65.1	14.4-17.6	0.2-0.4

Pagellus bellottii Steindachner, 1882 Family SPARIDAE

Shape: elliptic to pentagonal, ventral margin crenate. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: tubular, curved, strongly flexed posteriorly, ending close to the posterior-ventral margin. *Anterior region*: peaked to angled; rostrum short, broad, pointed; antirostrum very small, broad, round or pointed; excisura wide with a shallow notch. *Posterior region*: round to angled.

OL/TL	OH/OL	Circularity	Rectangularity
3.9-4.6	57.4-65.5	15.2-16.9	0.2-0.3

Pagellus bogaraveo (Brünnich, 1768) Family SPARIDAE

Shape: elliptic, margins crenate to irregular. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: tubular, curved, strongly flexed posteriorly, ending close to the posterior-ventral margin. *Anterior region*: angled to peaked; rostrum long, broad to narrow, round to pointed; antirostrum poorly developed to small, broad, round to pointed; excisura wide with a shallow, acute notch. *Posterior region*: angled to oblique.

OL/TL	OH/OL	Circularity	Rectangularity
3.2-3.7	51.0-65.8	14.5-19.7	0.2-0.3

Pagellus erythrinus (Linnaeus, 1758) Family SPARIDAE

Shape: approximately pentagonal, margins crenate *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: tubular, curved, slightly or strongly flexed from the middle region, ending close to the posterior-ventral margin. *Anterior region*: angled; rostrum short, broad, pointed; antirostrum poorly developed or small, broad, round; excisura wide with or without a shallow notch. *Posterior region*: angled.

OL/TL	OH/OL	Circularity	Rectangularity
3.2-4.7	63.2-67.7	14.9-15.8	0.2

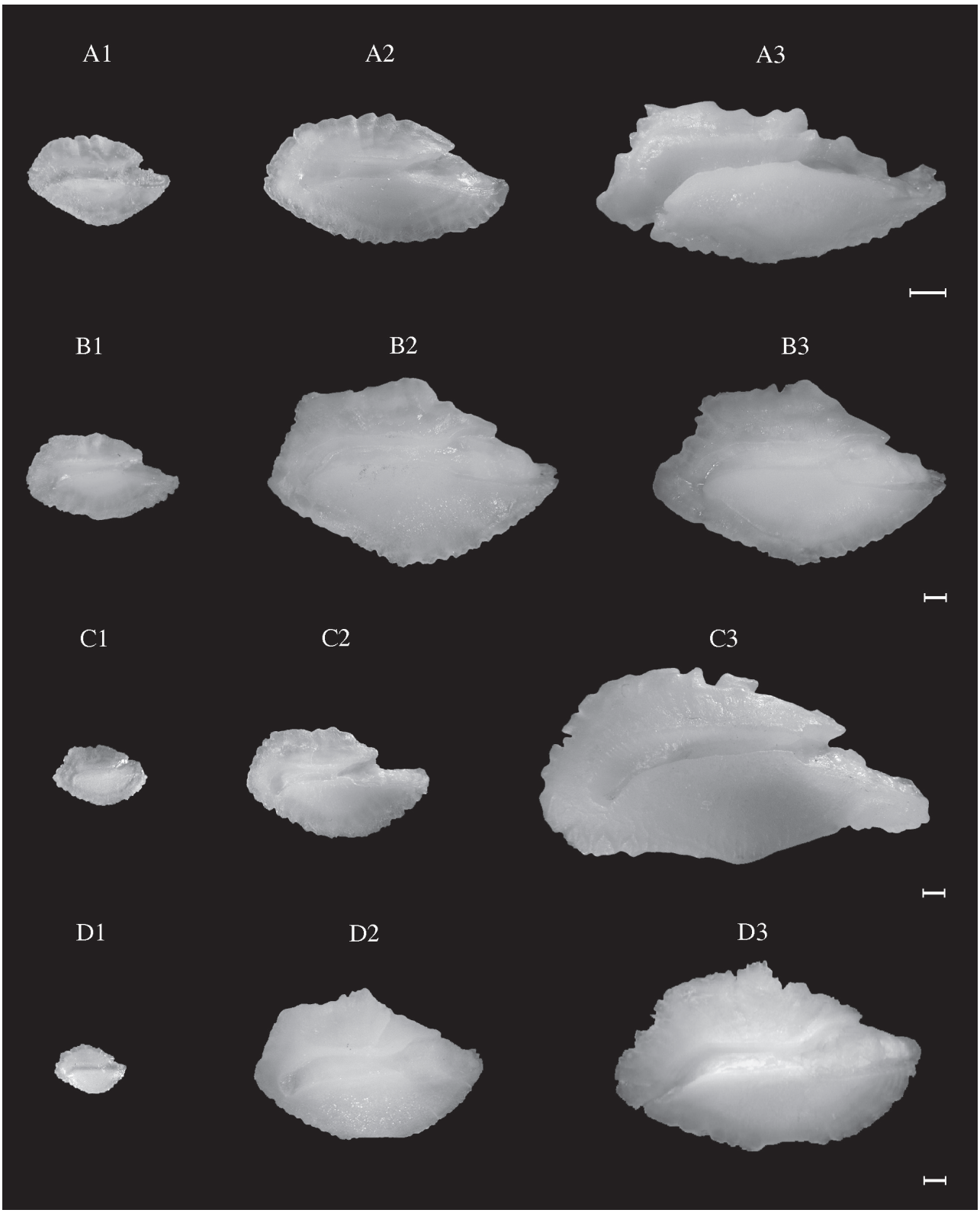

FIG. 60. – *Pagellus acarne*. TL: A1, 9.0 cm (WM); A2, 17.9 cm (NEA); A3, 26.0 cm (CEA).
Pagellus bellottii (CEA). TL: B1, 17.1 cm; B2, 29.2 cm; B3, 29.4 cm.
Pagellus bogaraveo. TL: C1, 13.5 cm (WM); C2, 24.2 cm (NEA); C3, 49.2 cm (CEA).
Pagellus erythrinus. TL: D1, 6.5 cm (WM); D2, 23.5 cm (CEA); D3, 41.0 cm (WM).
Scale bar = 1 mm.

Pagrus auriga Valenciennes, 1843 Family SPARIDAE

Shape: approximately pentagonal to elliptic, margins crenate to serrate. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: tubular, curved, strongly flexed from the middle region, ending close to the posterior-ventral margin. *Anterior region*: angled to peaked; rostrum short, broad, round to pointed; antirostrum poorly developed or small, broad, pointed; excisura wide with or without a shallow notch. *Posterior region*: angled to oblique.

OL/TL	OH/OL	Circularity	Rectangularity
2.6-3.2	58.2-70.7	15.7-18.0	0.2-0.3

Pagrus caeruleostictus (Valenciennes, 1830) Family SPARIDAE

Shape: pentagonal to elliptic, margins serrate to irregular. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: tubular, curved, strongly or markedly flexed from the middle region, ending close to the posterior-ventral margin. *Anterior region*: angled to peaked; rostrum short, broad, pointed; antirostrum poorly developed or small, broad, pointed; excisura wide with or without a shallow, acute notch. *Posterior region*: angled to oblique.

OL/TL	OH/OL	Circularity	Rectangularity
2.8-3.4	54.0-72.3	14.5-17.6	0.2-0.3

Pagrus pagrus (Linnaeus, 1758) Family SPARIDAE

Shape: elliptic, margins entire to dentate. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: tubular, curved, markedly flexed from the middle region, ending close to the posterior-ventral margin. *Anterior region*: angled to peaked; rostrum short, broad, pointed; antirostrum poorly developed or small, broad, pointed; excisura wide with or without a shallow notch. *Posterior region*: oblique.

OL/TL	OH/OL	Circularity	Rectangularity
2.2-3.7	55.5-60.8	15.2-20.0	0.2-0.3

Sarpa salpa (Linnaeus, 1758) Family SPARIDAE

Shape: elliptic, sharp-ended posteriorly, margins serrate. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: tubular, curved, strongly flexed from the middle region, ending close to the posterior-ventral margin. *Anterior region*: peaked; rostrum short, broad, pointed, tip can be flexed to dorsal margin; antirostrum poorly defined or relatively long, broad, pointed; excisura wide with or without an acute, deep notch. *Posterior region*: oblique, with a long, pointed end.

OL/TL	OH/OL	Circularity	Rectangularity
2.0-3.4	44.2-54.9	15.8-21.7	0.3-0.4

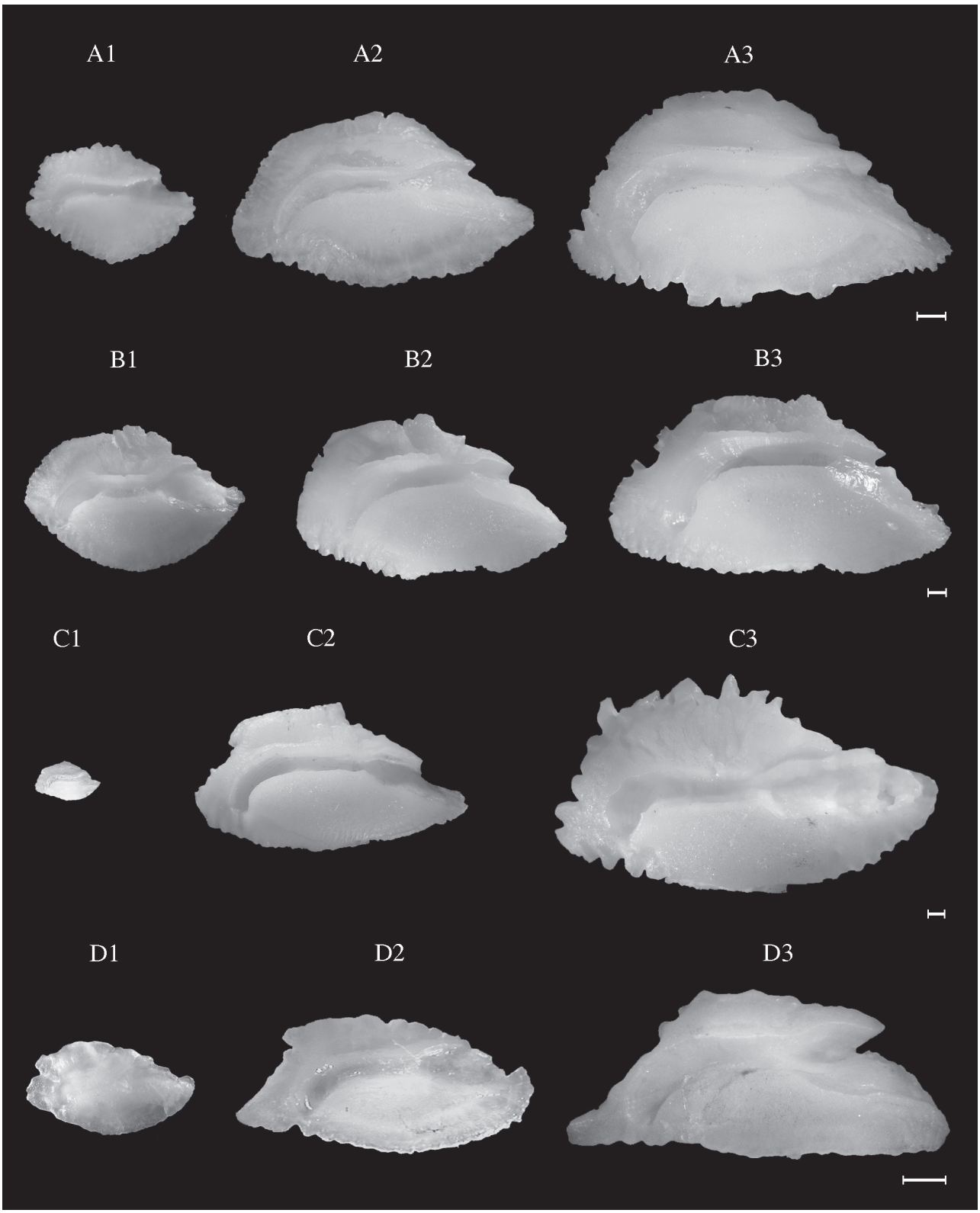

FIG. 61. – *Pagrus auriga* (CEA). TL: A1, 17.4 cm; A2, 31.7 cm; A3, 48.3 cm.
Pagrus caeruleostictus. TL: B1, 34.2 cm (NEA); B2, 46.6 cm (CEA); B3, 52.2 cm (CEA).
Pagrus pagrus. TL: C1, 10.0 cm (WM); C2, 41.0 cm (CEA); C3, 94.0 cm (NEA).
Sarpa salpa. TL: D1, 11.4 cm (NEA); D2, 24.5 cm (WM); D3, 43.0 cm (CEA).
Scale bar = 1 mm.

Sparus aurata Linnaeus, 1758 Family SPARIDAE

Shape: pentagonal to elliptic, margins serrate. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: tubular, curved, strongly flexed from the middle region, ending close to the posterior-ventral margin. *Anterior region*: angled to peaked; rostrum short, broad, pointed; antirostrum poorly defined or very small, broad, pointed; excisura wide without or a shallow notch. *Posterior region*: flattened to oblique.

OL/TL	OH/OL	Circularity	Rectangularity
2.8-3.1	51.2-65.3	16.8-18.0	0.2-0.3

Spondyliosoma cantharus (Linnaeus, 1758) Family SPARIDAE

Shape: elliptic, margins serrate. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: tubular, curved, strongly flexed from the middle region, ending close to the posterior-ventral margin. *Anterior region*: angled; rostrum short, broad, pointed; antirostrum poorly defined or very small, broad, pointed; excisura wide, with or without a shallow notch. *Posterior region*: angled to pointed-angled.

OL/TL	OH/OL	Circularity	Rectangularity
3.1-3.4	49.2-57.5	15.8-17.6	0.3

Centracanthus cirrus Rafinesque, 1810 Family CENTRACANTHIDAE

Shape: elliptic or slightly pentagonal, sinuate margins. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, as long as the cauda. *Cauda*: tubular, straight, ending close to the posterior margin. *Anterior region*: peaked; rostrum short, broad, sharp-ended; antirostrum short, broad, round; excisura wide with an acute notch. *Posterior region*: oblique to irregular.

OL/TL	OH/OL	Circularity	Rectangularity
3.0	57.6	17.8	0.3

Spicara flexuosa Rafinesque, 1810 Family CENTRACANTHIDAE

Shape: elliptic to pentagonal, posterior and dorsal margin sinuate. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel like or slightly discoidal, shorter than the cauda. *Cauda*: tubular, curved, strongly flexed posteriorly, ending close to the posterior margin. *Anterior region*: peaked; rostrum short, broad, sharp-ended or round; antirostrum poorly defined or short, broad, round; excisura wide with or without a shallow notch. *Posterior region*: angled to round-irregular.

OL/TL	OH/OL	Circularity	Rectangularity
3.5-3.7	61.8-69.6	15.5-16.0	0.2

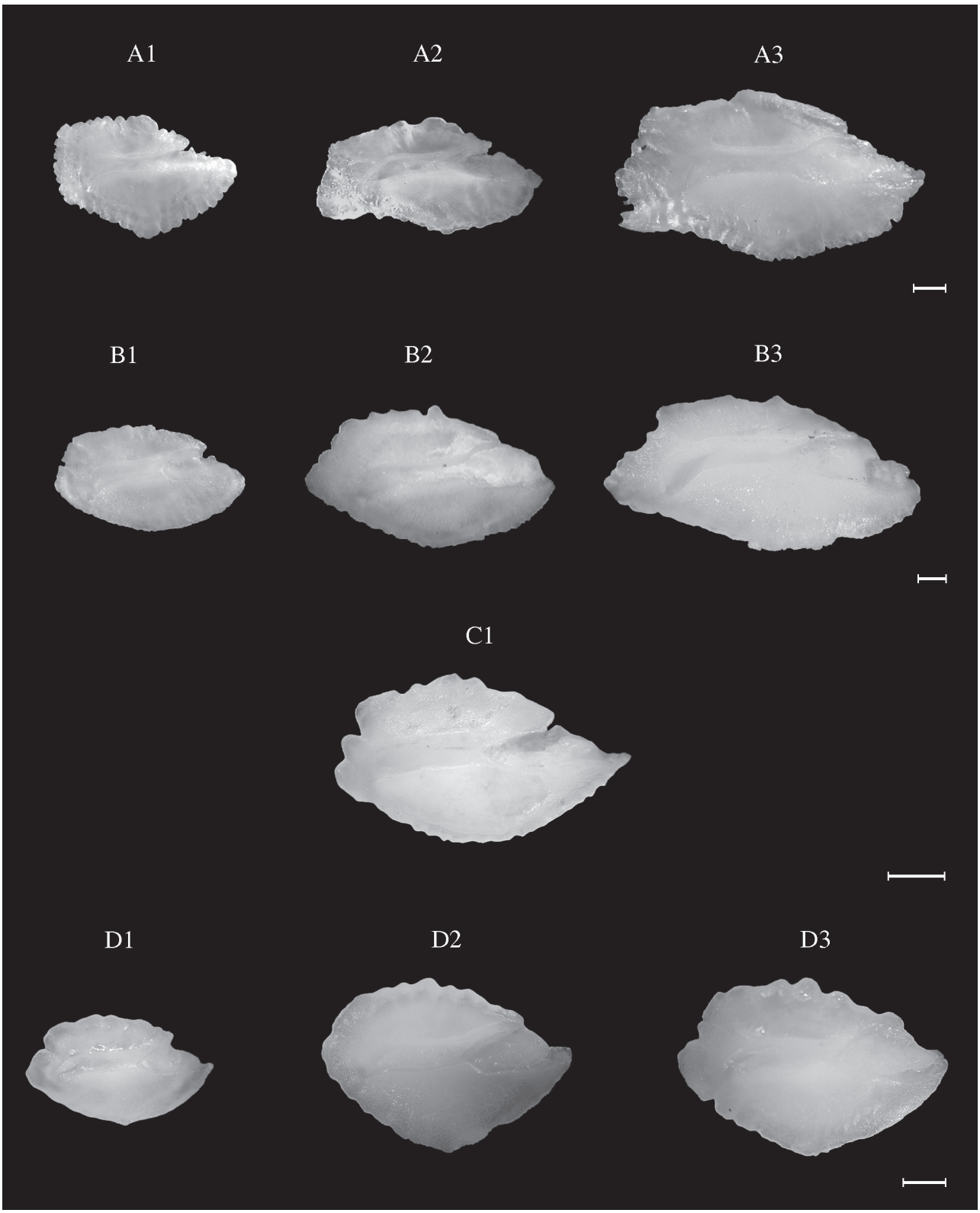

FIG. 62. – *Sparus aurata.* TL: A1, 17.8 cm (WM); A2, 22.5 cm (WM) ; A3, 32.4 cm (NEA).
Spondyliosoma cantharus. TL: B1, 18.6 cm (NEA); B2, 27.0 cm (WM); B3, 33.8 cm (CEA).
Centracanthus cirrus (WM). TL: C1, 17.0 cm.
Spicara flexuosa. TL: D1, 13.5 cm (WM); D2, 18.5 cm (NEA); D3, 20.5 cm (WM).
Scale bar = 1 mm.

Spicara maena (Linnaeus, 1758) Family CENTRACANTHIDAE

Shape: pentagonal to rhomboidal, dorsal margin sinuate. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like or slightly discoidal, shorter than the cauda. *Cauda*: tubular, curved, strongly flexed posteriorly, ending close to the posterior margin. *Anterior region*: peaked; rostrum short, broad, round; antirostrum very short, broad, round; excisura wide with or without a shallow notch. *Posterior region*: round to angled-irregular.

OL/TL	OH/OL	Circularity	Rectangularity
3.1-3.3	61.3-71.5	14.8-16.4	0.2

Spicara smaris (Linnaeus, 1758) Family CENTRACANTHIDAE

Shape: elliptic, dorso-posterior margin regularly lobed to sinuate. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: slightly discoidal, as long as the cauda. *Cauda*: tubular, curved, strongly flexed posteriorly, ending close to the posterior-ventral margin. *Anterior region*: peaked; rostrum short, broad, round (curved upwards in the larger otoliths); antirostrum poorly defined or very short, broad, round, expanded dorsally in the larger otoliths; excisura wide with or without a shallow notch. *Posterior region*: round to oblique.

OL/TL	OH/OL	Circularity	Rectangularity
3.0-3.8	55.6-57.2	16.0-16.9	0.3

Argyrosomus regius (Asso, 1801) Family SCIAENIDAE

Shape: elliptic to bullet-shaped. *Sulcus acusticus*: heterosulcoid, pseudo-ostial, supramedian. *Ostium*: lateral, markedly asymmetric, well developed, longer than the cauda, horizontal, occupying the anterior-dorsal area of the otolith. *Cauda*: tubular, curved, curled from the median region, ending close to the ventral margin. *Anterior region*: round to peaked; rostrum long, broad, round; antirostrum absent; excisura absent. *Posterior region*: round to flattened.

OL/FL	OH/OL	Circularity	Rectangularity
2.3-4.4	54.7-75.8	13.4-15.4	0.1-0.3

Atractoscion aequidens (Cuvier, 1830) Family SCIAENIDAE

Shape: oblong (it may appear close to bullet-shaped). *Sulcus acusticus*: heterosulcoid, pseudo-ostial, supramedian. *Ostium*: lateral, asymmetric, well developed, longer than the cauda, slightly ascending, completely occupying the anterior area of the otolith. *Cauda*: tubular, curved, curled from the median region, ending close to the ventral margin. *Anterior region*: peaked; rostrum long, broad, round; antirostrum absent; excisura absent. *Posterior region*: round.

OL/TL	OH/OL	Circularity	Rectangularity
2.8-3.4	51.6-55.2	15.3-15.4	0.3

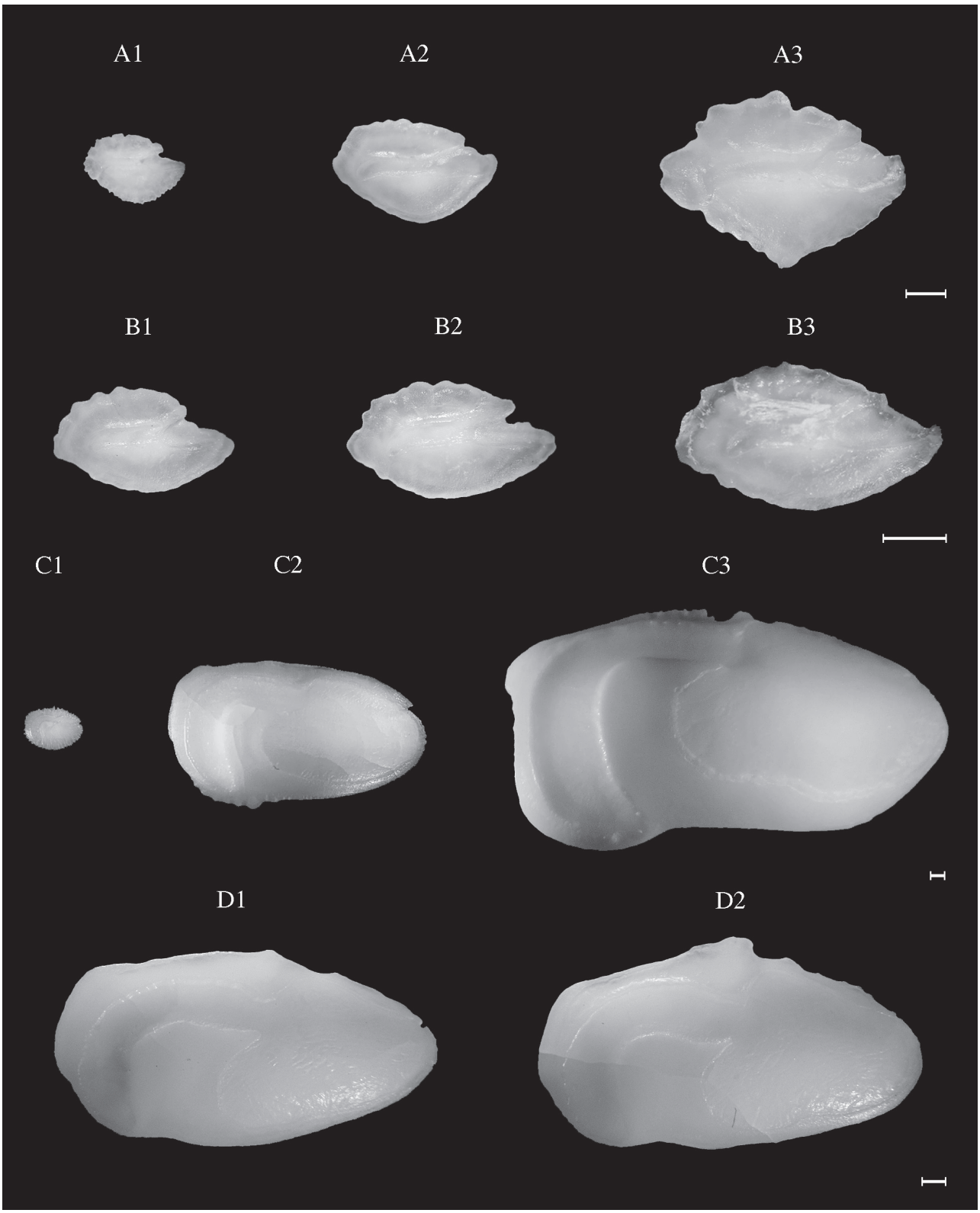

FIG. 63. – *Spicara maena* (WM). TL: A1, 7.7 cm; A2, 12.0 cm; A3, 19.5 cm.
Spicara smaris (WM). TL: B1, 9.0 cm; B2, 11.0 cm; B3, 13.5 cm.
Argyrosomus regius. TL: C1, 9.5 cm (NEA); C2, 60.8 cm (NEA); C3, 123.3 cm (CEA).
Atractoscion aequidens (CEA). TL: D1, 48.0 cm; D2, 55.0 cm.
Scale bar = 1 mm.

Pseudotolithus elongatus (Bowdich, 1825) Family Sciaenidae

Shape: rectangular. *Sulcus acusticus*: heterosulcoid, para-ostial, supramedian. *Ostium*: lateral, completely asymmetric, well developed, shorter than the cauda, ascending, occupying the anterior-central area of the otolith. *Cauda*: tubular, curved, curled from the medial-posterior region, ending close to the ventral margin, dorsal crista well developed making a curved dorsal margin. *Anterior region*: round to flattened; rostrum long, very broad, flattened; antirostrum absent; excisura absent. *Posterior region*: oblique to pointed.

OL/SL	OH/OL	Circularity	Rectangularity
5.1	59.9-61.8	15.9	0.2-0.3

Pseudotolithus senegalensis (Valenciennes, 1833) Family Sciaenidae

Shape: rectangular, with visible prominent calcareous concretions in the posterior-dorsal area. *Sulcus acusticus*: heterosulcoid, para-ostial, supramedian. *Ostium*: lateral, completely asymmetric, well developed, shorter than the cauda, ascending, occupying the anterior area of the otolith. *Cauda*: tubular, curved, curled from the medial-posterior region, ending close to the ventral margin, dorsal crista well developed. *Anterior region*: flattened; rostrum long, very broad, flattened; antirostrum absent; excisura absent. *Posterior region*: oblique to pointed.

OL/SL	OH/OL	Circularity	Rectangularity
4.9-5.3	52.4-59.0	16.9-18.5	0.3

Pseudotolithus senegallus (Cuvier, 1830) Family Sciaenidae

Shape: triangular , with visible prominent calcareous concretions in the posterior-dorsal area. *Sulcus acusticus*: heterosulcoid, para-ostial, supramedian. *Ostium*: lateral, completely asymmetric, well developed, shorter than the cauda, ascending, occupying anterior-central area of the otolith. *Cauda*: tubular, curved, curled from the posterior region, ending close to the ventral margin, dorsal crista well developed. *Anterior region*: round to oblique; rostrum long, very broad, round; antirostrum absent; excisura absent. *Posterior region*: oblique to pointed.

OL/SL	OH/OL	Circularity	Rectangularity
5.2	51.4-53.9	17.5	0.3

Pseudotolithus typus Bleeker, 1863 Family Sciaenidae

Shape: rectangular, with visible calcareous concretions in the dorsal area. *Sulcus acusticus*: heterosulcoid, para-ostial, supramedian. *Ostium*: lateral, completely asymmetric, well developed, shorter than the cauda, ascending, occupying anterior-central area of the otolith. *Cauda*: tubular, curved, markedly flexed from the posterior region, ending close to the ventral margin, dorsal crista well developed. *Anterior region*: round; rostrum long, very broad, round; antirostrum absent; excisura absent. *Posterior region*: oblique to pointed.

OL/SL	OH/OL	Circularity	Rectangularity
5.2-5.3	47.3-49.2	17.0-17.3	0.3-0.4

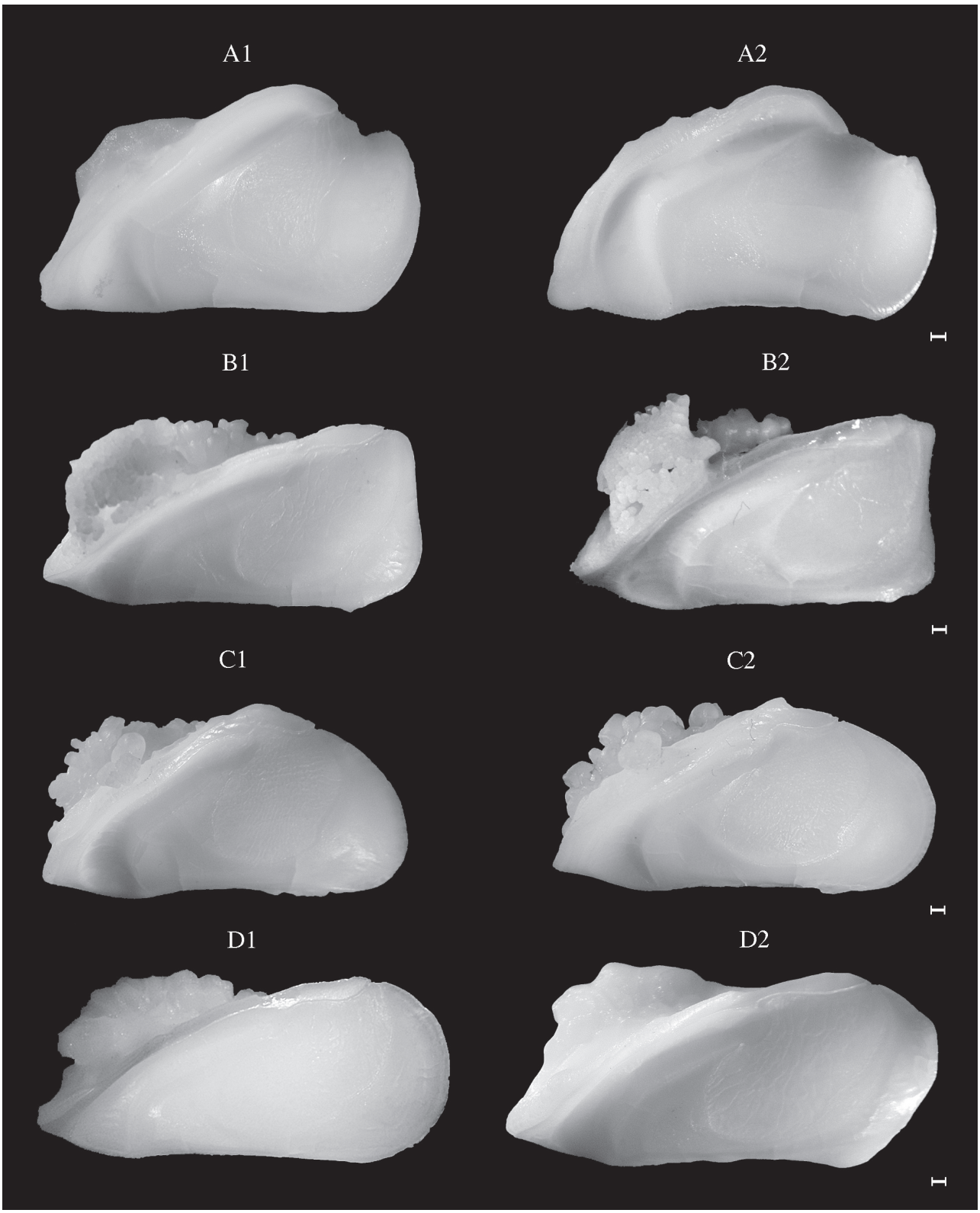

FIG. 64. – *Pseudotolithus elongatus* (CEA). SL, A1, 47.9 cm; A2, 48.1 cm.
Pseudotolithus senegalensis (CEA). SL, B1, 47.0 cm; B2, 50.6 cm.
Pseudotolithus senegallus (CEA). SL, C1, 47.0 cm; C2, 48.9 cm.
Pseudotolithus typus (CEA). SL, D1, 52.6 cm; D2, 54.2 cm.
Scale bar = 1 mm.

Sciaena umbra Linnaeus, 1758 Family SCIAENIDAE

Shape: circular. *Sulcus acusticus*: heterosulcoid, pseudo-ostial, supramedian. *Ostium*: lateral, markedly asymmetric, well developed, longer than the cauda, horizontal, occupying the anterior area of the otolith. *Cauda*: tubular, curved, curled from the median region, ending close to the ventral margin. *Anterior region*: round; rostrum long, broad, round; antirostrum absent; excisura absent. *Posterior region*: oblique to flattened.

OL/TL	OH/OL	Circularity	Rectangularity
2.9-3.4	80.6-96.1	15.7-17.8	0.0-0.1

Umbrina canariensis Valenciennes, 1843 Family SCIAENIDAE

Shape: oval, dorsal margin angled. *Sulcus acusticus*: heterosulcoid, pseudo-ostial, supramedian. *Ostium*: lateral, markedly asymmetric, well developed, longer than the cauda, horizontal, occupying the anterior area of the otolith. *Cauda*: tubular, curved, curled from the anterior region, ending close to the ventral margin. *Anterior region*: round; rostrum long, broad, round; antirostrum absent; excisura absent. *Posterior region*: oblique to round.

OL/TL	OH/OL	Circularity	Rectangularity
3.6-4.2	68.6-81.0	13.7-18.3	0.1-0.2

Umbrina cirrosa (Linnaeus, 1758) Family SCIAENIDAE

Shape: oval, dorsal margin flattened. *Sulcus acusticus*: heterosulcoid, pseudo-ostial, supramedian. *Ostium*: lateral, markedly asymmetric, well developed, longer than the cauda, horizontal, occupying the anterior area of the otolith. *Cauda*: tubular, curved, curled from the anterior region, ending close to the ventral margin. *Anterior region*: round; rostrum long, broad, round; antirostrum absent; excisura with a very small notch. *Posterior region*: oblique to round.

OL/TL	OH/OL	Circularity	Rectangularity
2.8-5.0	68.3-80.1	15.8-17.0	0.1-0.2

Umbrina ronchus Valenciennes, 1843 Family SCIAENIDAE

Shape: oval, dorsal margin angled. *Sulcus acusticus*: heterosulcoid, pseudo-ostial, supramedian. *Ostium*: lateral, markedly asymmetric, well developed, longer than the cauda, horizontal, occupying the anterior area of the otolith. *Cauda*: tubular, curved, curled from the anterior region, ending close to the ventral margin. *Anterior region*: round; rostrum long, broad, round; antirostrum absent; excisura absent. *Posterior region*: round.

OL/TL	OH/OL	Circularity	Rectangularity
3.9-4.1	70.9-74.0	13.4-13.6	0.2

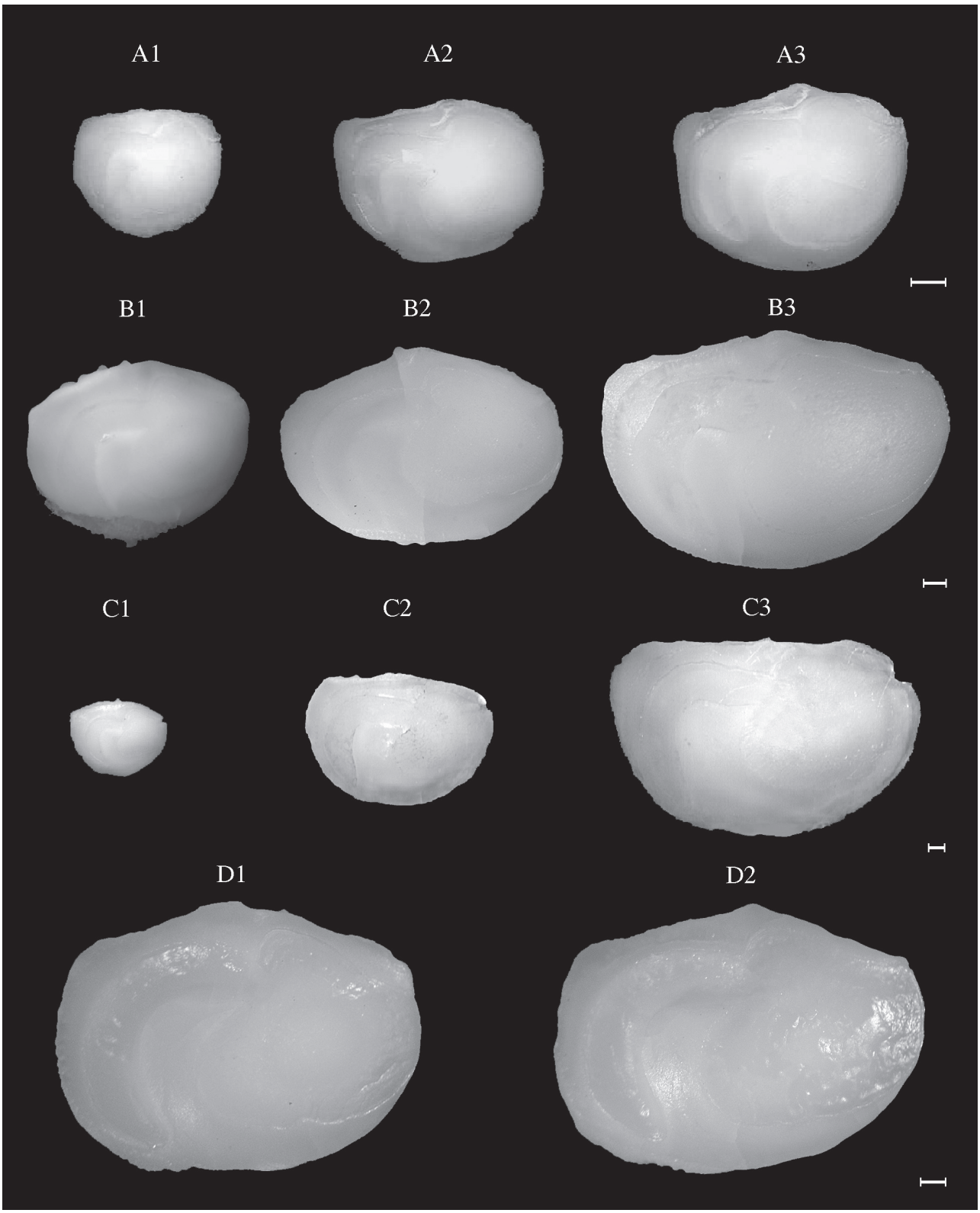

FIG. 65. – *Sciaena umbra* (WM). TL: A1, 25.0 cm; A2, 35.0 cm; A3, 49.9 cm.
Umbrina canariensis. TL: B1, 23.5 cm (WM); B2, 30.2 cm (CEA); B3, 40.0 cm (CEA).
Umbrina cirrosa (WM). TL: C1, 11.5 cm; C2, 32.5 cm; C3, 54.0 cm.
Umbrina ronchus (CEA). TL: D1, 33.4 cm; D2, 36.6 cm.
Scale bar = 1 mm.

Mullus barbatus Linnaeus, 1758 Family MULLIDAE

Shape: elliptic to oval, margins crenate to irregular. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: tubular, curved, markedly flexed from the middle region, ending close to the posterior margin. *Anterior region*: peaked; rostrum short, broad, pointed, blunt or irregular; antirostrum short, broad, pointed, sometimes fused with the rostrum; excisura wide with a deep, acute notch. *Posterior region*: round to angled-irregular.

OL/TL	OH/OL	Circularity	Rectangularity
1.8-2.2	70.3-80.0	16.9-17.3	0.1-0.2

Mullus surmuletus Linnaeus, 1758 Family MULLIDAE

Shape: oval, margins crenate to irregular. *Sulcus acusticus*: heterosulcoid, ostial (it may appear ostio-caudal), median. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: tubular, curved, markedly flexed from the middle region, ending close to the posterior margin. *Anterior region*: round to peaked; rostrum short, broad, round or pointed; antirostrum short, broad, pointed, it may be fused with rostrum; excisura relatively wide with a shallow, acute notch. *Posterior region*: round to round**-**oblique.

OL/TL	OH/OL	Circularity	Rectangularity
1.4-2.0	69.5-75.4	14.0-19.3	0.1-0.2

Cepola macrophthalma (Linnaeus, 1758) Family CEPOLIDAE

Shape: elliptic, posterior margin sinuate. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: elliptic, longer than the cauda. *Cauda*: elliptic, straight, ending far from the posterior-dorsal margin. *Anterior region*: peaked; rostrum short, broad, slightly pointed; antirostrum poorly defined, short, broad, round; excisura wide without a notch. *Posterior region*: angled.

OL/TL	OH/OL	Circularity	Rectangularity
0.8-2.1	54.6-61.0	14.6-16.2	0.2-0.3

Abudefduf luridus (Cuvier, 1830) Family POMACENTRIDAE

Shape: oblong. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: tubular, curved, strongly flexed posteriorly, ending close to the posterior-ventral margin. *Anterior region*: peaked; rostrum short, very broad, blunt; antirostrum poorly defined; excisura wide without a notch. *Posterior region*: round to oblique.

OL/FL	OH/OL	Circularity	Rectangularity
4.7	56.9	15.2	0.3

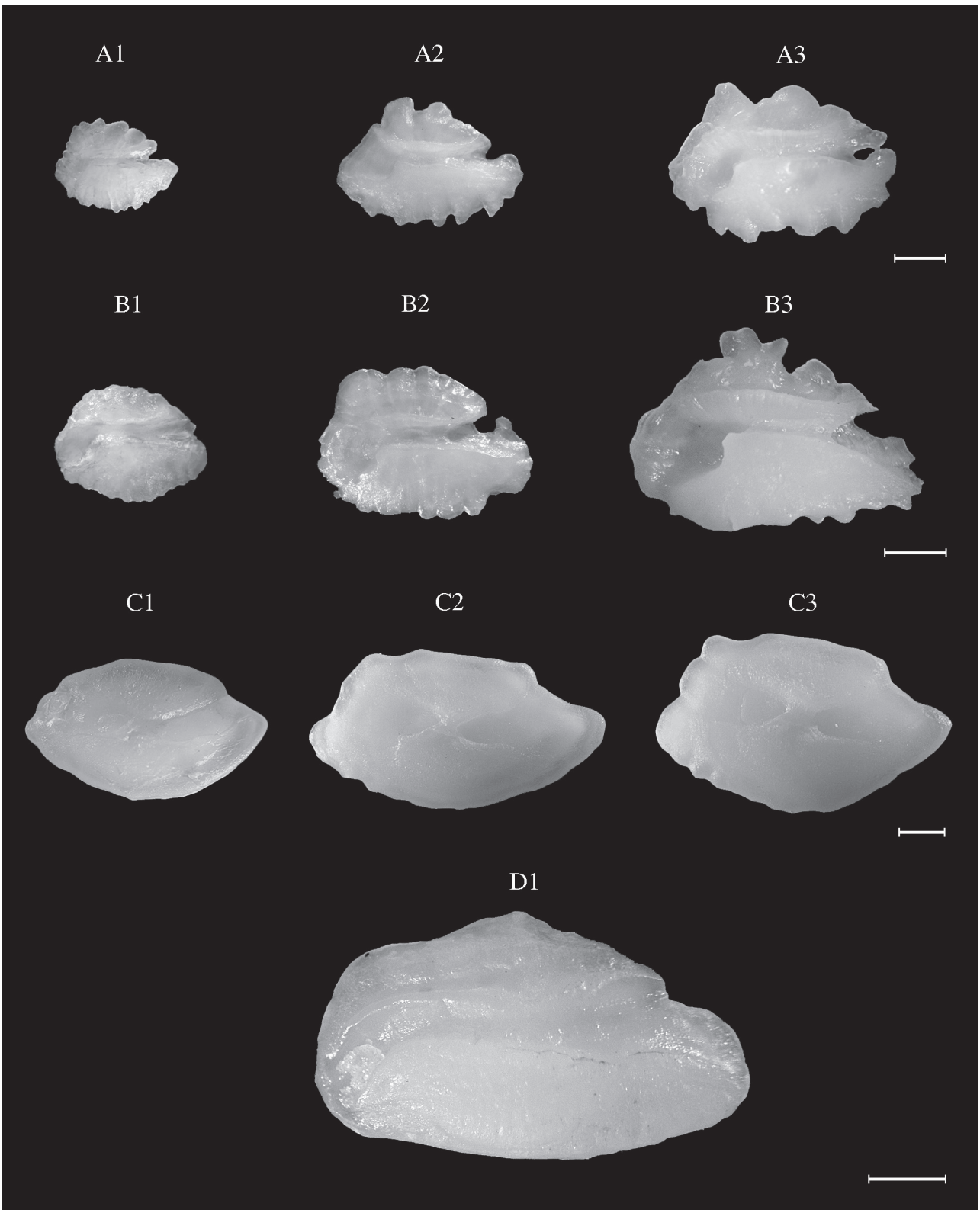

FIG. 66. – *Mullus barbatus*. TL: A1, 10.8 cm (WM); A2, 17.9 cm (NEA); A3, 24.5 cm (WM).
Mullus surmuletus. TL: B1, 12.3 cm (WM); B2, 23.0 cm (NEA); B3, 33.0 cm (CEA).
Cepola macrophthalma. TL: C1, 25.0 cm (WM); C2, 52.4 cm (NEA); C3, 84.9 cm (NEA).
Abudefduf luridus (CEA). FL, D1,11.7 cm.
Scale bar = 1 mm.

Chromis chromis (Linnaeus, 1758) Family POMACENTRIDAE

Shape: elliptic to slightly pentagonal, dorsal margin lobate with a prominent central indentation in the largest otoliths, ventral margin slightly crenate. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, longer than the cauda. *Cauda*: tubular, curved, strongly to markedly flexed posteriorly, ending close to the posterior-ventral margin. *Anterior region*: peaked; rostrum short, very broad, pointed; antirostrum very small, round; excisura wide without a notch. *Posterior region*: round to angled.

OL/TL	OH/OL	Circularity	Rectangularity
4.8-5.4	59.3-62.0	15.1-15.8	0.2-0.3

Chromis limbata (Valenciennes, 1833) Family POMACENTRIDAE

Shape: elliptic or approximately pentagonal to oblong, dorsal margin with a prominent central indentation, ventral margin crenate to sinuate. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: tubular, curved, strongly to markedly flexed posteriorly, ending close to the posterior-ventral margin. *Anterior region*: peaked; rostrum short, very broad, pointed; antirostrum poorly defined; excisura wide without a notch. *Posterior region*: angled to oblique-irregular.

OL/TL	OH/OL	Circularity	Rectangularity
4.6-4.8	56.1-59.3	15.7-16.0	0.3

Acantholabrus palloni (Risso, 1810) Family LABRIDAE

Shape: elliptic or cuneiform, ventral margin crenate to serrate. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: elliptic, straight, ending close to the posterior margin. *Anterior region*: peaked; rostrum short to long, broad, pointed; antirostrum short to long, broad to narrow, round to pointed; excisura wide, with a deep, acute notch. *Posterior region*: pointed, irregular in the larger otoliths.

OL/TL	OH/OL	Circularity	Rectangularity
2.2-2.8	47.2-52.3	18.2-22.6	0.3-0.4

Bodianus scrofa (Valenciennes, 1839) Family LABRIDAE

Shape: cuneiform truncated anteriorly, ventral margin crenate. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, shorter than the cauda, separated from the cauda by a conspicuous collum. *Cauda*: tubular, slightly sinuous, ending far from to the posterior margin. *Anterior region*: double-peaked joined by a protuberance of ostial colliculum, it may appear triple-peaked; rostrum short, very broad, pointed; antirostrum short, broad, round; excisura wide, without a notch. *Posterior region*: pointed.

OL/TL	OH/OL	Circularity	Rectangularity
1.9-2.1	48.0-51.4	16.4-18.2	0.3-0.4

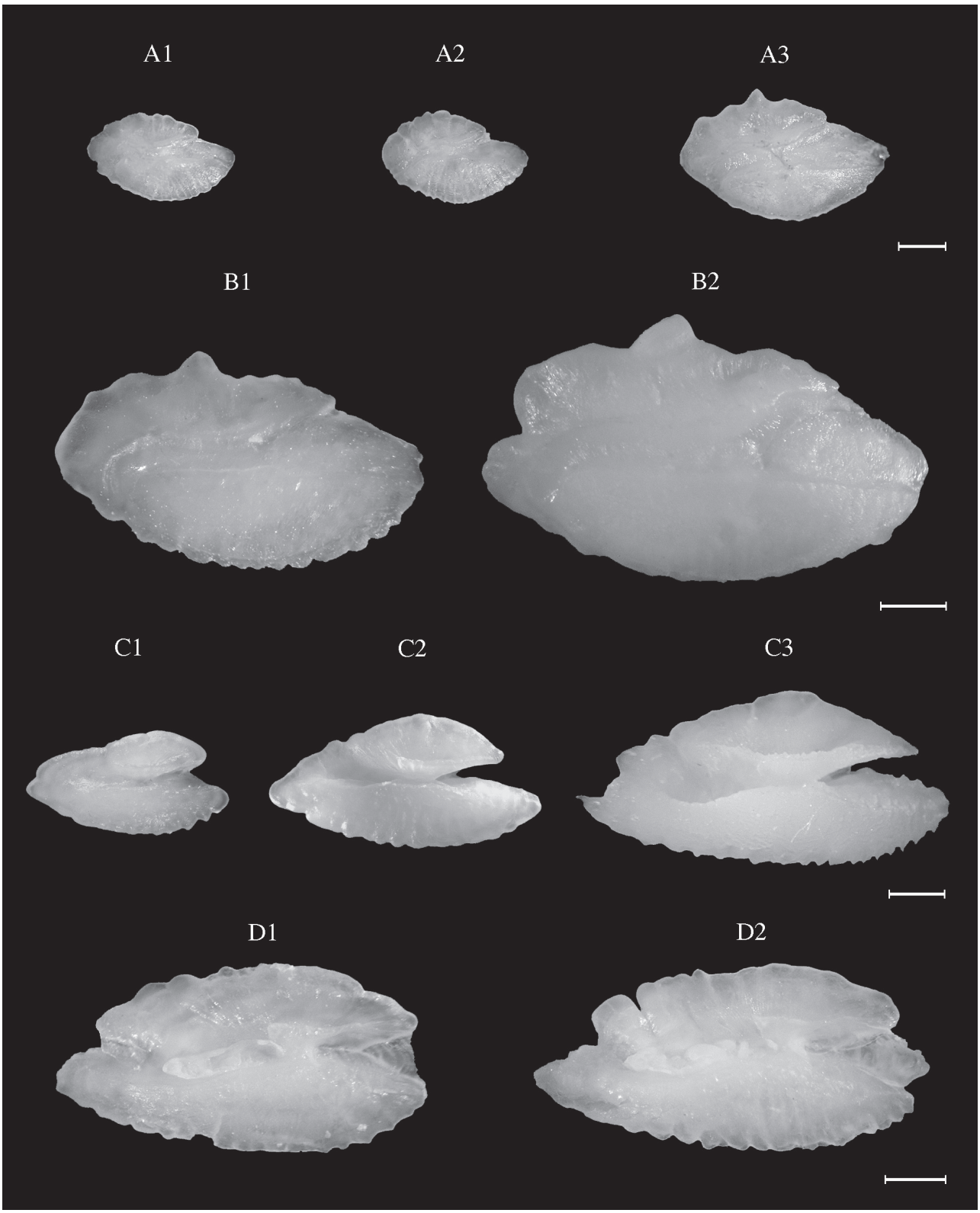

FIG. 67. – *Chromis chromis* (WM). TL: A1, 5.5 cm; A2, 6.5 cm; A3, 9.0 cm.
Chromis limbata (CEA). TL: B1, 11.6 cm; B2, 14.5 cm.
Acantholabrus palloni. TL: C1, 12.5 cm (WM); C2, 20.8 cm (NEA); C3, 29.5 cm (CEA).
Bodianus scrofa (CEA). TL: D1, 30.7cm; D2, 31.1 cm.
Scale bar = 1 mm.

Centrolabrus trutta (Lowe, 1834) Family LABRIDAE

Shape: oval-cuneiform, postero-dorsal margin slightly lobed. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: elliptic, straight, ending very close to the posterior margin. *Anterior region*: peaked; rostrum long, broad, pointed; antirostrum short, broad, pointed; excisura wide, with a deep, acute notch. *Posterior region*: round and irregular.

OL/TL	OH/OL	Circularity	Rectangularity
1.5	54.3	19.7	0.3

Coris julis (Linnaeus, 1758) Family LABRIDAE

Shape: cuneiform to oval, margins entire. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: elliptic, straight, ending very close to the posterior margin. *Anterior region*: peaked; rostrum very short, broad, round to pointed; antirostrum poorly defined or short, broad, round or pointed; excisura wide, with or without a shallow notch. *Posterior region*: pointed.

OL/TL	OH/OL	Circularity	Rectangularity
1.5-2.0	55.0-60.4	15.3-17.9	0.3

Ctenolabrus rupestris (Linnaeus, 1758) Family LABRIDAE

Shape: oval-cuneiform, margins entire. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: elliptic, straight, ending very close to the posterior margin. *Anterior region*: peaked; rostrum long, broad, pointed; antirostrum short, broad, round; excisura wide, with a deep, acute notch. *Posterior region*: pointed.

OL/TL	OH/OL	Circularity	Rectangularity
2.3-2.6	54.0-62.0	18.8-19.0	0.2-0.3

Labrus bergylta Ascanius, 1767 Family LABRIDAE

Shape: cuneiform, postero-dorsal margin lobed and ventral margin crenate. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, similar to the cauda in size, separated from the cauda by a conspicuous collum. *Cauda*: elliptic, straight, ending very close to the posterior margin. *Anterior region*: peaked; rostrum short, broad, pointed; antirostrum short, broad, round; excisura wide, with a deep, acute notch. *Posterior region*: pointed.

OL/TL	OH/OL	Circularity	Rectangularity
1.9	50.4	20.9	0.3

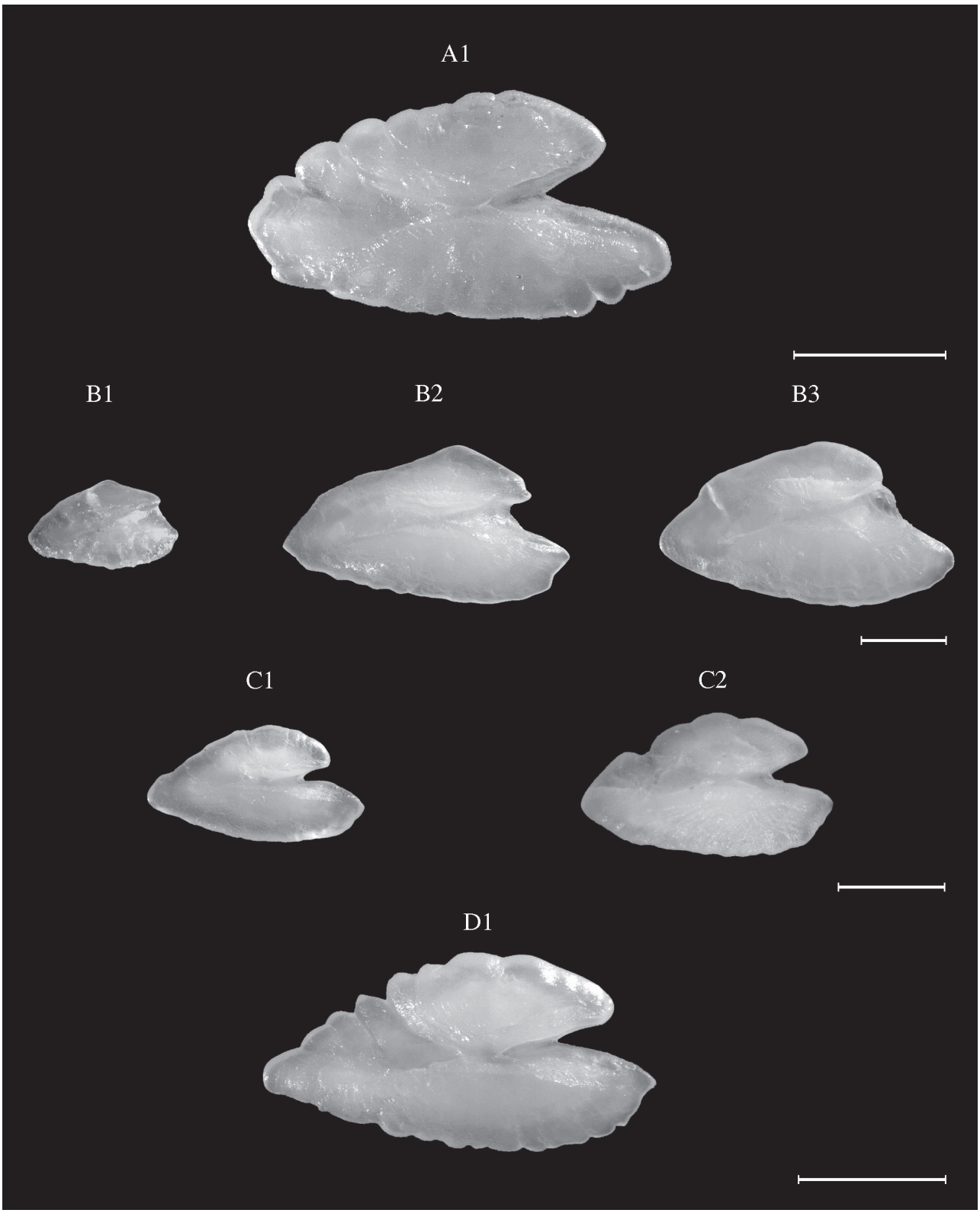

FIG. 68. – *Centrolabrus trutta* (NEA). TL: A1, 18.5 cm.
Coris julis. TL: B1, 8.5 cm (WM); B2, 17.8 cm (NEA); B3, 22.7 cm (NEA).
Ctenolabrus rupestris (NEA). TL: C1, 8.9 cm.
Labrus bergylta (NEA). TL: D1, 13.8 cm.
Scale bar = 1 mm.

Labrus merula Linnaeus, 1758 Family LABRIDAE

Shape: cuneiform, margins sinuous. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, similar to the cauda in size, separated from the cauda by a conspicuous collum. *Cauda*: elliptic, straight, ending very close to the posterior margin. *Anterior region*: peaked; rostrum long, broad, pointed; antirostrum short, narrow, markedly pointed; excisura wide, with a deep, acute notch. *Posterior region*: pointed.

OL/TL	OH/OL	Circularity	Rectangularity
1.4-1.7	46.5-51.7	22.4-23.1	0.3-0.4

Labrus mixtus Linnaeus, 1758 Family LABRIDAE

Shape: oval, margins sinuous or entire. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, longer than the cauda, separated from the cauda by a conspicuous collum. *Cauda*: elliptic, straight, ending very close to the posterior margin. *Anterior region*: peaked; rostrum long, broad, pointed; antirostrum short, narrow, pointed; excisura wide, with a deep, acute notch. *Posterior region*: pointed.

OL/TL	OH/OL	Circularity	Rectangularity
1.9-2.1	52.6-54.8	19.2-20.6	0.3

Labrus viridis Linnaeus, 1758 Family LABRIDAE

Shape: cuneiform, margins sinuous or entire. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, shorter than the cauda, separated from the cauda by a conspicuous collum. *Cauda*: elliptic, straight, ending very close to the posterior margin. *Anterior region*: peaked; rostrum short, broad, pointed; antirostrum short, broad, round; excisura wide, with a deep, acute notch. *Posterior region*: pointed.

OL/TL	OH/OL	Circularity	Rectangularity
1.6-1.9	49.5-50.4	17.2-19.1	0.3

Symphodus bailloni (Valenciennes, 1839) Family LABRIDAE

Shape: cuneiform, margins sinuous. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, shorter than the cauda, separated from the cauda by a conspicuous collum. *Cauda*: elliptic, straight, ending very close to the posterior margin. *Anterior region*: peaked; rostrum short, broad, pointed to round; antirostrum short, broad, round; excisura wide, with a deep, acute notch. *Posterior region*: oblique to irregular.

OL/TL	OH/OL	Circularity	Rectangularity
1.4-2.0	52.5-62.9	17.3-19.8	0.2-0.3

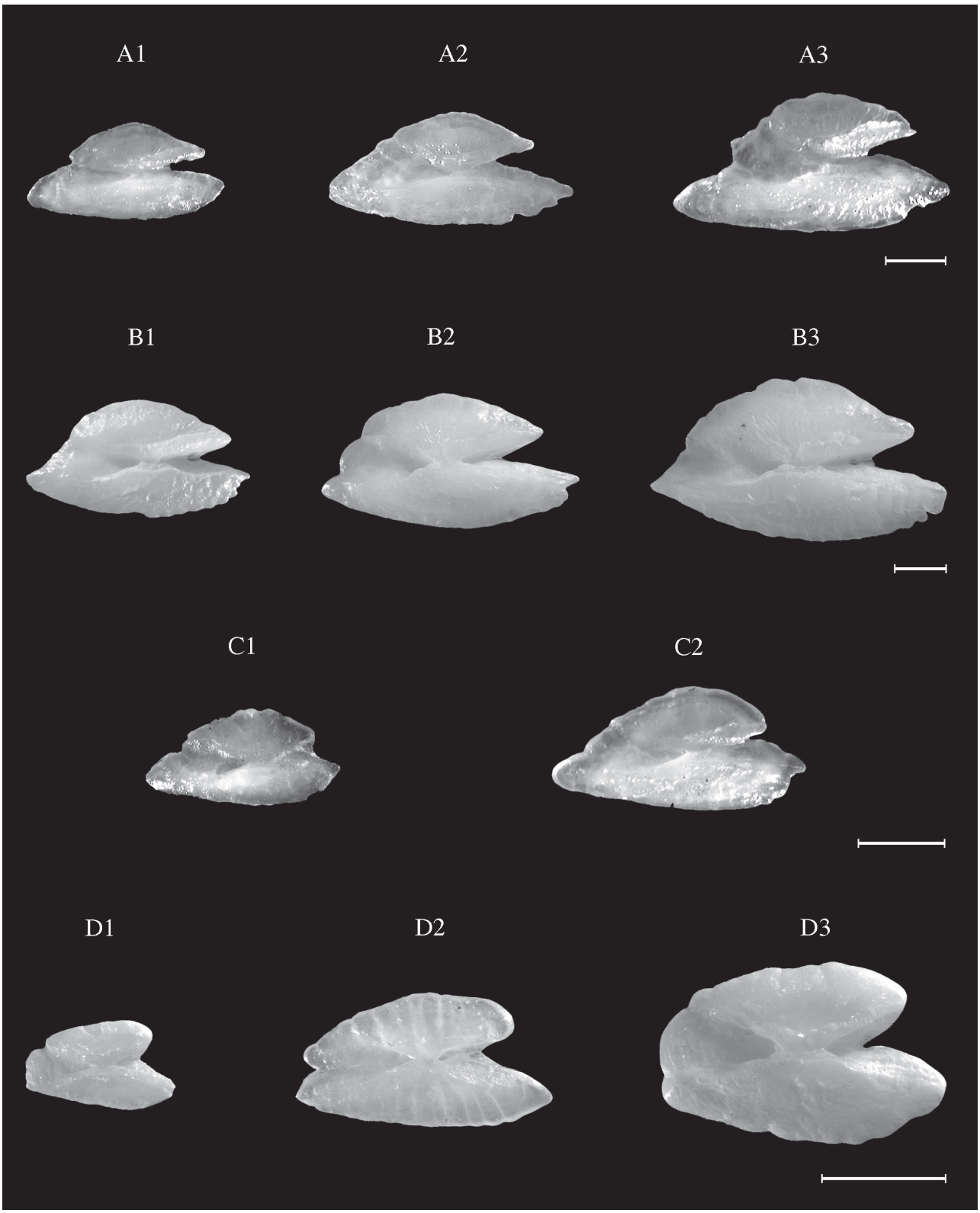

FIG. 69. – *Labrus merula* (WM). TL: A1, 19.0 cm; A2, 28.5 cm; A3, 33.0 cm.
Labrus mixtus (NEA). TL: B1, 20.3 cm; B2, 24.1 cm; B3, 29.7 cm.
Labrus viridis (WM). TL: C1, 11.5 cm; C2, 18.5 cm.
Symphodus bailloni (NEA). TL: D1, 6.0 cm; D2, 11.3 cm; D3, 16.5 cm.
Scale bar = 1 mm.

Symphodus cinereus (Bonnaterre, 1788) Family LABRIDAE

Shape: oval to cuneiform, margins sinuous. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, shorter than the cauda, separated from the cauda by a conspicuous collum. *Cauda*: elliptic, straight, ending very close to the posterior margin. *Anterior region*: peaked; rostrum short, broad, pointed or round; antirostrum short, broad, pointed or round; excisura wide, with a shallow, round or a deep, acute notch. *Posterior region*: round or pointed to irregular.

OL/TL	OH/OL	Circularity	Rectangularity
4.5-6.3	55.7-67.9	15.5-19.4	0.2-0.3

Symphodus doderleini Jordan, 1891 Family LABRIDAE

Shape: oval to cuneiform, dorsal margin sinuous to irregular. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, shorter than the cauda, separated form the cauda by a conspicuous collum. *Cauda*: elliptic, straight, ending very close to the posterior margin. *Anterior region*: peaked; rostrum short to long, broad, round to pointed; antirostrum poorly defined to short, broad, round to pointed; excisura wide, with or without a deep, acute notch. *Posterior region*: round to pointed.

OL/TL	OH/OL	Circularity	Rectangularity
2.3-2.7	50.6-55.5	15.7-21.7	0.3

Symphodus mediterraneus (Linnaeus, 1758) Family LABRIDAE

Shape: cuneiform, margins sinuous. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, shorter than the cauda, separated from the cauda by a conspicuous collum. *Cauda*: elliptic, straight, ending very close to the posterior margin. *Anterior region*: peaked; rostrum short, broad, pointed; antirostrum short, broad, pointed to round; excisura wide, with a shallow or a deep, acute notch. *Posterior region*: round to pointed to irregular.

OL/TL	OH/OL	Circularity	Rectangularity
2.0-2.2	54.2-60.4	16.9-19.3	0.3

Symphodus melops (Linnaeus, 1758) Family LABRIDAE

Shape: oval to cuneiform, dorsal margin slightly lobed in the larger otoliths. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, shorter than the cauda, separated from the cauda by a conspicuous collum. *Cauda*: elliptic, straight, ending very close to the posterior margin. *Anterior region*: peaked; rostrum short to long, broad, round to pointed; antirostrum short, broad, round; excisura wide, with a shallow or a deep, acute notch. *Posterior region*: pointed.

OL/TL	OH/OL	Circularity	Rectangularity
3.5-5.0	61.8-63.3	17.1-19.1	0.2

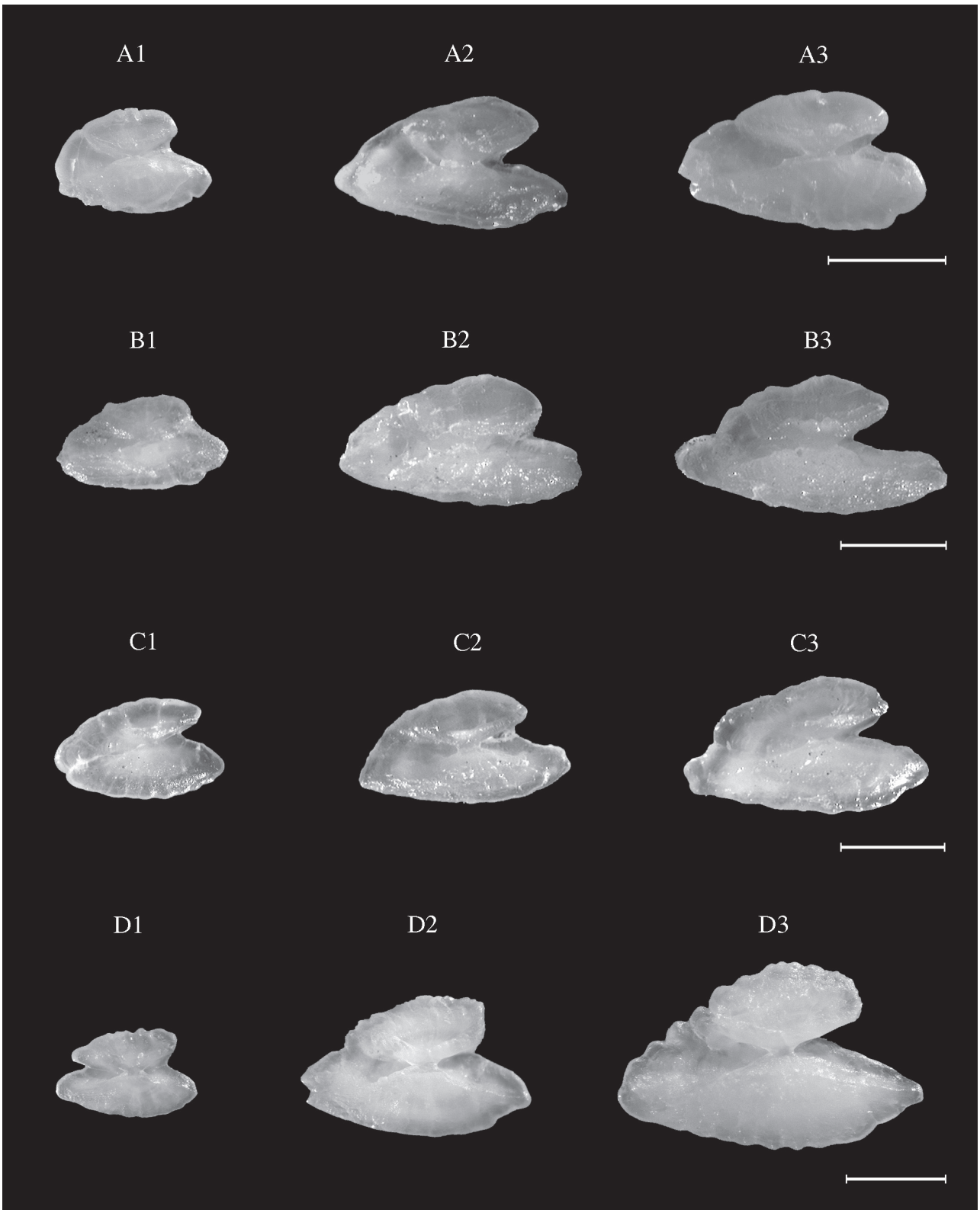

FIG. 70. – *Symphodus cinereus*. TL: A1, 6.6 cm (NEA); A2, 8.5 cm (WM); A3, 12.0 cm (NEA).
Symphodus doderleini (WM). TL: B1, 7.0 cm; B2, 9.0 cm; B3, 9.5 cm.
Symphodus mediterraneus (WM). TL: C1, 8.0 cm; C2, 9.0 cm; C3, 11.0 cm.
Symphodus melops (NEA). TL: D1, 8.0 cm; D2, 17.2 cm; D3, 22.3 cm.
Scale bar = 1 mm.

Symphodus ocellatus (Forsskål, 1775) Family LABRIDAE

Shape: oval to cuneiform, margins irregular in the larger otoliths. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, shorter than the cauda, separated from the cauda by a conspicuous collum. *Cauda*: elliptic, straight, ending very close to the posterior margin. *Anterior region*: peaked; rostrum very short, broad, round; antirostrum short, broad, round; excisura wide, with or without a shallow notch. *Posterior region*: round to oblique, irregular.

OL/TL	OH/OL	Circularity	Rectangularity
2.0-2.2	64.3-70.3	14.8-17.8	0.2

Symphodus roissali (Risso, 1810) Family LABRIDAE

Shape: cuneiform, margins entire. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: elliptic, straight, ending very close to the posterior margin. *Anterior region*: peaked; rostrum very short, broad, round; antirostrum short, broad, round; excisura wide, with a shallow notch. *Posterior region*: pointed.

OL/TL	OH/OL	Circularity	Rectangularity
2.0	60.9	16.5	0.2

Symphodus rostratus (Bloch, 1791) Family LABRIDAE

Shape: cuneiform, margins sinuous. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, shorter than the cauda, separated from the cauda by a conspicuous collum. *Cauda*: elliptic, straight, ending very close to the posterior margin. *Anterior region*: peaked; rostrum short, broad, round; antirostrum poorly defined or short, broad, round to pointed; excisura wide, with an acute notch. *Posterior region*: slightly pointed to oblique.

OL/TL	OH/OL	Circularity	Rectangularity
2.0-2.4	60.1-64.9	14.9-17.8	0.1-0.3

Symphodus tinca (Linnaeus, 1758) Family LABRIDAE

Shape: cuneiform, dorsal margin irregular and ventral margin crenate in the larger otoliths. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, shorter than the cauda, separated from the cauda by a conspicuous collum. *Cauda*: elliptic, straight, ending very close to the posterior margin. *Anterior region*: peaked; rostrum short to long, broad to narrow, pointed; antirostrum short to long, broad, round to round-pointed; excisura wide, with a deep, acute notch. *Posterior region*: pointed to pointed-oblique.

OL/TL	OH/OL	Circularity	Rectangularity
1.3-2.4	51.7-59.1	17.3-22.7	0.3

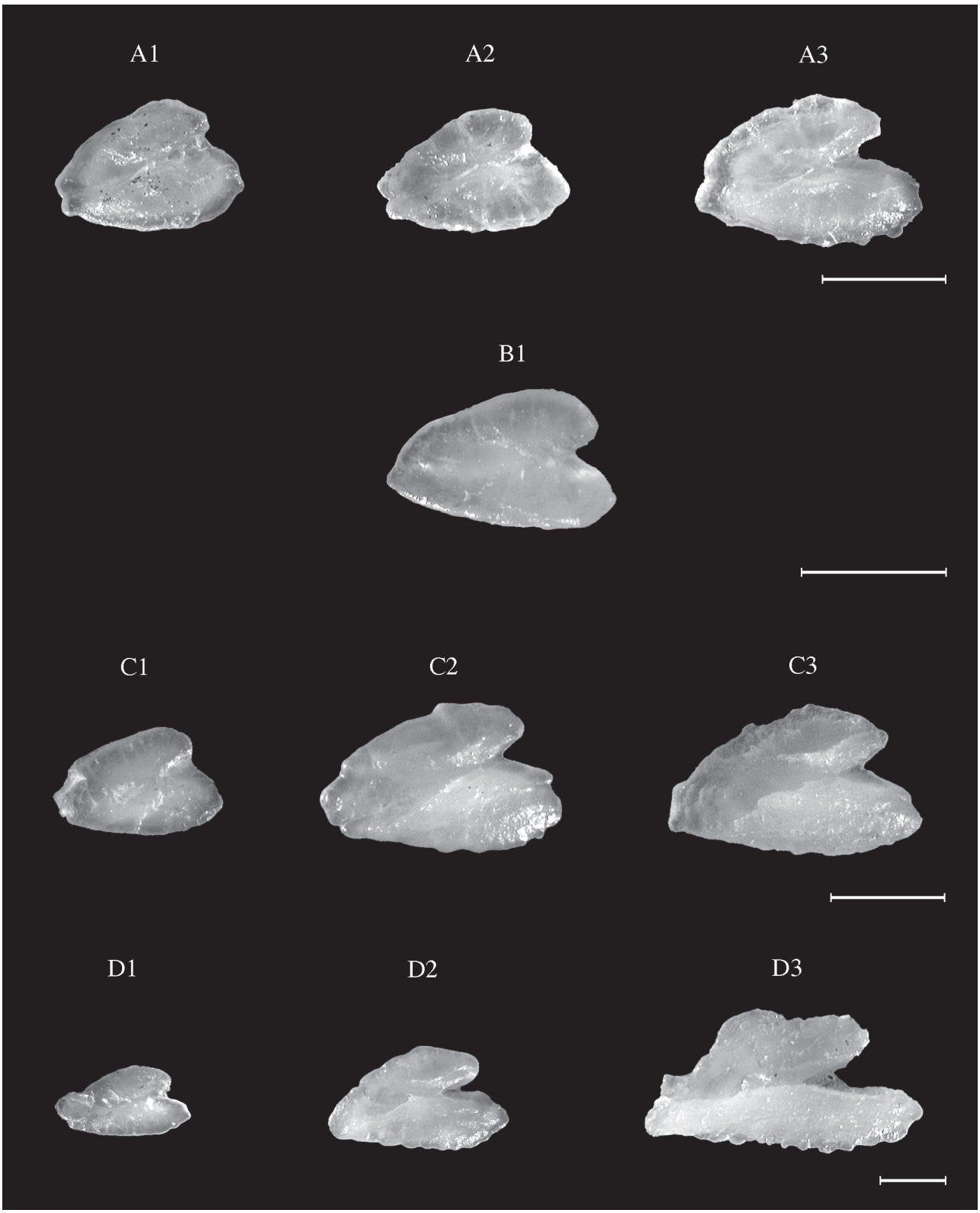

FIG. 71. – *Symphodus ocellatus* (WM). TL: A1, 7.0 cm; A2, 7.5 cm; A3, 9.0 cm.
Symphodus roissali (WM). TL: B1, 8.0 cm.
Symphodus rostratus (WM). TL: C1, 6.0 cm; C2, 10.0 cm; C3, 11.0 cm.
Symphodus tinca (WM). TL: D1, 8.5 cm; D2, 16.0 cm; D3, 32.0 cm.
Scale bar = 1 mm.

Thalassoma pavo (Linnaeus, 1758) Family LABRIDAE

Shape: cuneiform to rectangular, margins irregular in the larger otoliths. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: tubular, curved, ending close to the postero-ventral margin. *Anterior region*: peaked to almost double-peaked; rostrum very short, broad, pointed to blunt; antirostrum very short, broad, round to pointed; excisura wide, with a shallow notch. *Posterior region*: oblique to pointed-irregular.

OL/TL	OH/OL	Circularity	Rectangularity
1.8-2.5	50.6-53.3	16.3-18.3	0.3

Xyrichthys novacula (Linnaeus, 1758) Family LABRIDAE

Shape: discoidal, ventral margin lobate to crenate. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: tubular, longer than the cauda. *Cauda*: tubular, curved, ending far from the posterior margin. *Anterior region*: round; rostrum short, broad, round; antirostrum very short, broad, round; excisura narrow, with a shallow or acute notch. *Posterior region*: round.

OL/TL	OH/OL	Circularity	Rectangularity
2.0-2.1	82.6-90.8	13.6-15.1	0.1

Sparisoma cretense (Linnaeus, 1758) Family SCARIDAE

Shape: cuneiform to rectangular, ventral margin with irregular indentations. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: elliptic, slightly shorter than the cauda. *Cauda*: elliptic, straight, ending next to the posterior margin. *Anterior region*: double-peaked; rostrum and antirostrum short, broad, blunt-irregular and pointed respectively; excisura narrow with a deep notch. *Posterior region*: angled to oblique-pointed.

OL/TL	OH/OL	Circularity	Rectangularity
1.7-1.8	51.5-62.0	16.6-20.3	0.2-0.3

Sparisoma rubripinne (Valenciennes, 1840) Family SCARIDAE

Shape: approximately trapezoidal. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: elliptic, shorter than the cauda. *Cauda*: elliptic, straight, ending close to the posterior margin. *Anterior region*: double-peaked; rostrum and antirostrum very short, broad, blunt-irregular and pointed respectively; excisura narrow with a deep notch. *Posterior region*: oblique to irregular (more oblique than *S. cretense*).

OL/TL	OH/OL	Circularity	Rectangularity
1.3-1.4	53.2-54.6	20.2-20.6	0.3

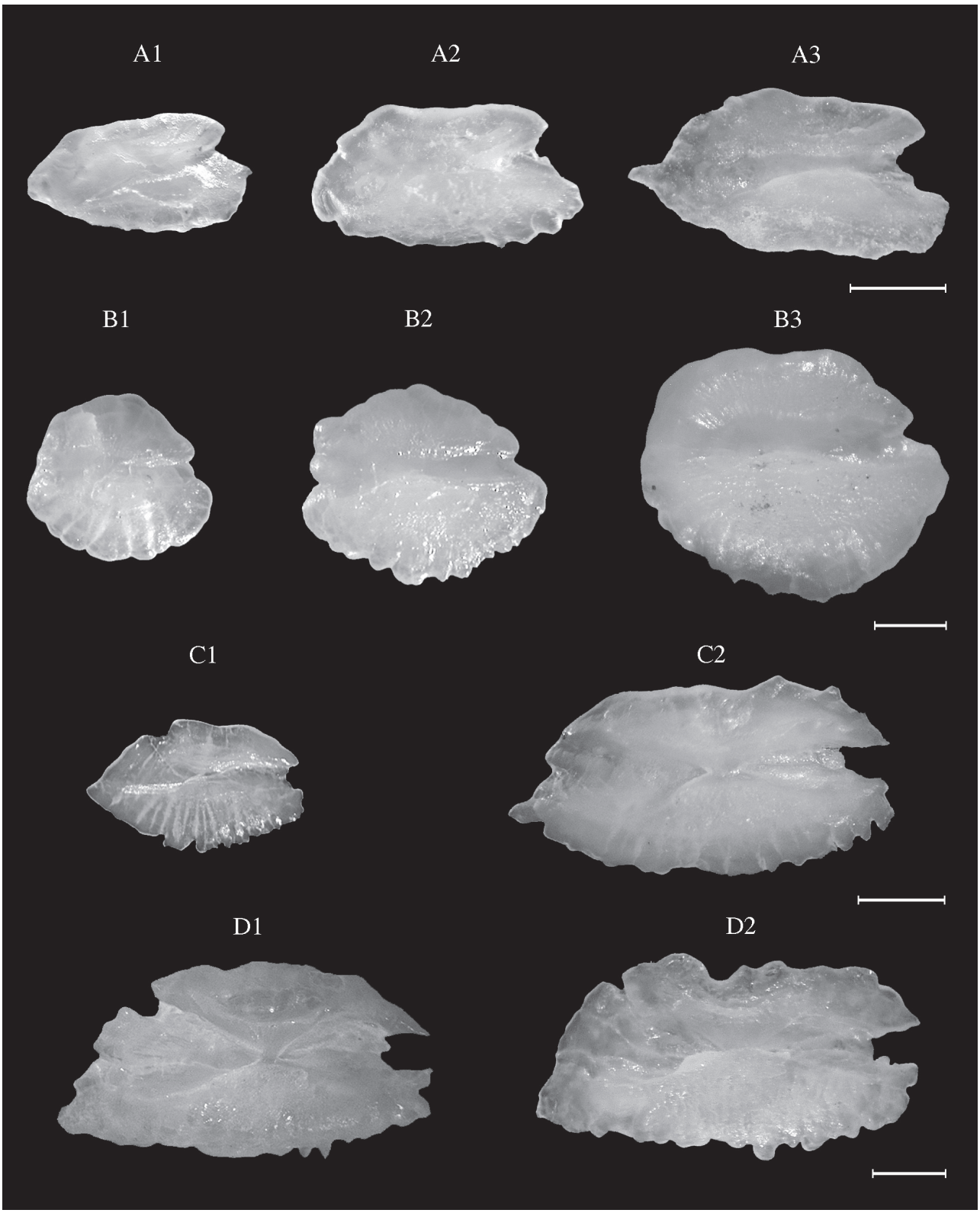

FIG. 72. – *Thalassoma pavo*. TL: A1, 9.2 cm (WM); A2, 15.9 cm (CEA); A3, 16.0 cm (CEA).
Xyrichthys novacula. TL: B1, 12.5 cm (WM); B2, 15.5 cm (WM); B3, 19.5 cm (CEA).
Sparisoma cretense (CEA). TL: C1, 14.3 cm; C2, 24.5 cm.
Sparisoma rubipinne (CEA). TL: D1, 38.0 cm; D2, 38.0 cm.
Scale bar = 1 mm.

Melanostigma atlanticum Koefoed, 1952 Family ZOARCIDAE

Shape: oval or circular. *Sulcus acusticus*: heterosulcoid, mesial, median. *Ostium*: oval, as long as the cauda, ending close to the anterior margin. *Cauda*: oval, straight, ascending, ending far from the posterior margin. *Anterior region*: round to peaked. *Posterior region*: round.

OL/TL	OH/OL	Circularity	Rectangularity
1.0-1.1	65.6-83.2	13.0-13.7	0.1-0.2

Chiasmodon niger Johnson, 1864 Family CHIASMODONTIDAE

Shape: elliptic, margins entire. *Sulcus acusticus*: archaesulcoid, ostial median. *Ostium* and *cauda*: not clearly differentiated, ending in the middle of the otolith. *Anterior region*: peaked; rostrum short, broad, pointed; antirostrum absent; excisura narrow without a notch. *Posterior region*: round.

OL/TL	OH/OL	Circularity	Rectangularity
1.8-1.9	55.8-56.1	14.7-14.9	0.3

Ammodytes tobianus Linnaeus, 1758 Family AMMODYTIDAE

Shape: lanceolated to oblong, dorsal margin sinuate to entire. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, longer or similar to the cauda in size. *Cauda*: tubular, straight, ending half way to the posterior margin. *Anterior region*: peaked or blunt; rostrum small, short, peaked; antirostrum absent or poorly defined; excisura narrow without a notch. *Posterior region*: round to angled.

OL/TL	OH/OL	Circularity	Rectangularity
2.1	33.7-48.8	16.1-20.5	0.3-0.5

Gymnammodytes cicerelus (Rafinesque, 1810) Family AMMODYTIDAE

Shape: lanceolated, dorsal margin sinuate. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: tubular, straight, ending in the middle of the otolith. *Anterior region*: round or peaked; rostrum short, broad, round; antirostrum poorly defined or short, round; excisura narrow with a shallow notch. *Posterior region*: round to oblique.

OL/TL	OH/OL	Circularity	Rectangularity
1.7-1.8	44.6-45.0	16.3-17.7	0.4

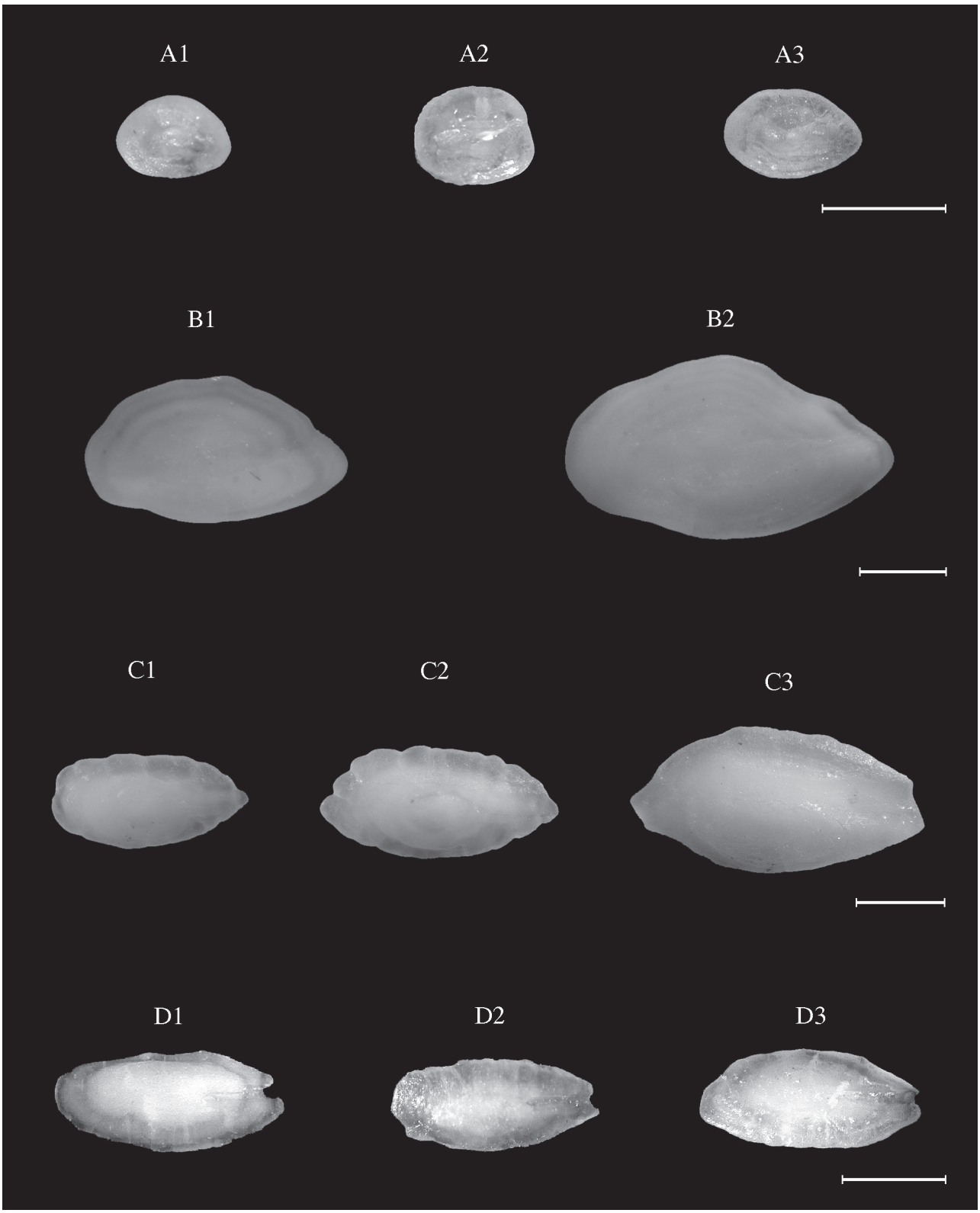

FIG. 73. – *Melanostigma atlanticum* (WM). TL: A1, 8.0 cm; A2, 9.5 cm; A3, 11.0 cm.
Chiasmodon niger (CEA). TL: B1, 16.0 cm; B2, 20.5 cm.
Ammodytes tobianus (NEA). TL: C1, 10.5 cm; C2, 12.7 cm; C3, 15.7 cm.
Gymnammodytes cicerelus (WM). TL: D1, 11.5 cm; D2, 12.0 cm; D3, 12.5 cm.
Scale bar = 1 mm.

Gymnammodytes semisquamatus (Jourdain, 1879) Family AMMODYTIDAE

Shape: oblong, dorsal margin partially or completely sinuate. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: tubular, straight, ending before the middle of the otolith. *Anterior region*: round; rostrum short, broad, blunt; antirostrum poorly defined or short, round; excisura narrow with or without a shallow notch. *Posterior region*: round or oblique.

OL/TL	OH/OL	Circularity	Rectangularity
1.4-1.8	44.0-48.0	15.9-17.7	0.4

Hyperoplus lanceolatus (Le Sauvage, 1824) Family AMMODYTIDAE

Shape: lanceolated, dorsal margin sinuate. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: tubular, straight, slightly ascending, ending half way to the posterior margin. *Anterior region*: pointed; rostrum short, broad, peaked; antirostrum absent; excisura narrow without a notch. *Posterior region*: round or oblique.

OL/TL	OH/OL	Circularity	Rectangularity
1.7-1.8	38.7-42.3	17.5-19.0	0.4

Echiichthys vipera (Cuvier, 1829) Family TRACHINIDAE

Shape: fusiform. *Sulcus acusticus*: heterosulcoid, ostial, supramedian. *Ostium*: tubular, concave, longer than the cauda. *Cauda*: tubular, curved, slightly flexed posteriorly, ending half way to the posterior margin. *Anterior region*: peaked; rostrum very small, narrow, sharply pointed; antirostrum absent; excisura narrow without a notch. *Posterior region*: pointed.

OL/TL	OH/OL	Circularity	Rectangularity
4.0-4.6	35.1-41.3	17.8-19.1	0.4-0.5

Trachinus draco Linnaeus, 1758 Family TRACHINIDAE

Shape: elliptic or lanceolated. *Sulcus acusticus*: heterosulcoid, ostial, supramedian. *Ostium*: tubular, concave, longer than the cauda. *Cauda*: tubular, curved, slightly flexed posteriorly, ending half way to the posterior margin. *Anterior region*: peaked; rostrum very small, broad, pointed; antirostrum absent; excisura very narrow without a notch. *Posterior region*: oblique.

OL/TL	OH/OL	Circularity	Rectangularity
2.0-3.5	44.2-51.4	15.8-16.6	0.3-0.4

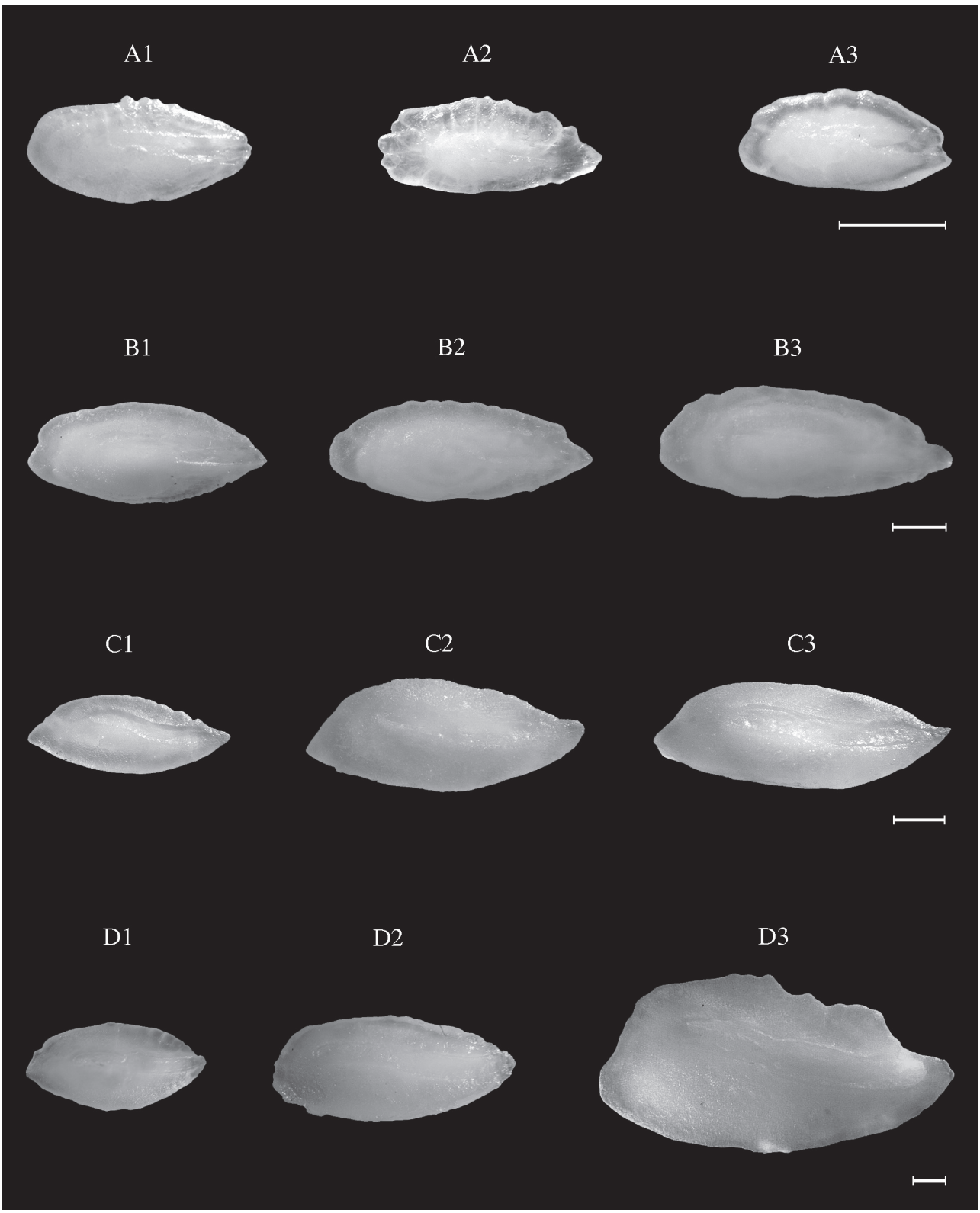

FIG. 74. – *Gymnammodytes semisquamatus* (WM). TL: A1, 11.6 cm; A2, 13.0 cm; A3, 14.0 cm.
Hyperoplus lanceolatus (NEA). TL: B1, 24.3 cm; B2, 27.3 cm; B3, 31.8 cm.
Echiichthys vipera (NEA). TL: C1, 8.3 cm; C2, 11.4 cm; C3, 13.9 cm.
Trachinus draco. TL: D1, 11.0 cm (WM); D2, 20.7 cm (CEA); D3, 35.5 cm (NEA).
Scale bar = 1 mm.

Trachinus radiatus Cuvier, 1829 Family TRACHINIDAE

Shape: elliptic or lanceolated, very irregular postero-dorsal margins in the larger otoliths. *Sulcus acusticus*: heterosulcoid, ostial, supramedian. *Ostium*: tubular, concave, longer than the cauda. *Cauda*: tubular, curved, slightly flexed posteriorly, ending half way to the posterior margin. *Anterior region*: peaked; rostrum very small, broad, pointed; antirostrum absent; excisura very narrow without a notch. *Posterior region*: oblique to irregular.

OL/TL	OH/OL	Circularity	Rectangularity
3.3-3.8	43.2-48.6	16.6-19.0	0.4

Uranoscopus scaber Linnaeus, 1758 Family URANOSCOPIDAE

Shape: oval, dorsal margin crenate to serrate. *Sulcus acusticus*: archaesulcoid, pseudo-ostial, median. *Ostium and cauda*: undifferentiated, tubular, slightly concave dorsally, ending far from the posterior margin. *Anterior region*: slightly peaked. *Posterior region*: round to blunt.

OL/TL	OH/OL	Circularity	Rectangularity
3.9-4.3	51.1-52.4	15.3-16.4	0.3

Tripterygion delaisi Cadenat and Blache, 1970 Family TRIPTERYGIIDAE

Shape: fusiform. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, longer than the cauda. *Cauda*: elliptic, ending far from the posterior margin. *Anterior region*: peaked; rostrum long, broad, pointed; antirostrum absent; excisura wide with or without a slightly shallow notch. *Posterior region*: peaked.

OL/TL	OH/OL	Circularity	Rectangularity
4.3	40.3-44.4	17.8-19.5	0.4

Blennius ocellaris Linnaeus, 1758 Family BLENNIIDAE

Shape: oval to elliptic. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: elliptic, longer than the cauda. *Cauda*: elliptic, straight, ending far from the posterior margin. *Anterior region*: peaked; rostrum short to elongated, broad, round to sharp curving to the dorsal area; antirostrum absent in the small otoliths and short, broad, round in the largest ones; excisura small to wide with a deep, acute notch. *Posterior region*: round in the smaller otoliths and angled or irregular in the largest ones.

OL/TL	OH/OL	Circularity	Rectangularity
1.9-2.8	51.6-64.7	14.2-22.3	0.2-0.3

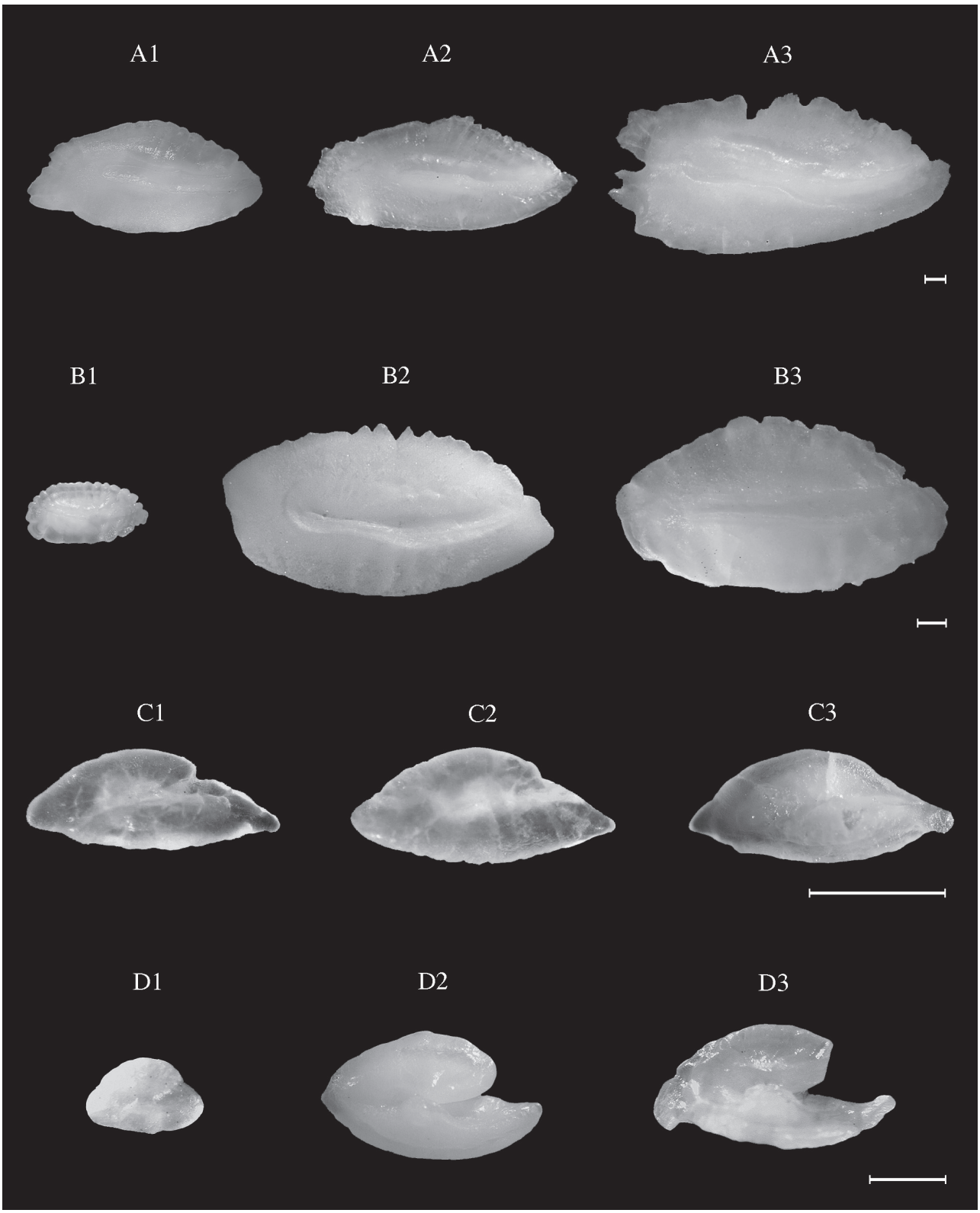

FIG. 75. – *Trachinus radiatus*. TL: A1, 28.0 cm (WM); A2, 35.5 cm (CEA); A3, 47.0 cm (CEA).
Uranoscopus scaber. TL: B1, 9.5 cm (WM); B2, 28.1 cm (NEA); B3, 28.2 cm (CEA).
Tripterygion delaisi. TL: C1, no available (WM); C2, no available (WM); C3, 4.5 cm (CEA).
Blennius ocellaris. TL: D1, 5.5 cm (WM); D2, 12.5 cm (NEA); D3, 16.0 cm (WM).
Scale bar = 1 mm.

Coryphoblennius galerita (Linnaeus, 1758) Family BLENNIIDAE

Shape: cuneiform. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: elliptic, longer than the cauda. *Cauda*: elliptic, straight, ending close to the posterior margin. *Anterior region*: peaked to double-peaked; rostrum short, broad, pointed; antirostrum short, broad, round to pointed; excisura relatively wide with a conspicuous round notch in the largest otoliths. *Posterior region*: oblique to angled.

OL/TL	OH/OL	Circularity	Rectangularity
1.7-2.0	60.2-67.3	16.3-19.0	0.2-0.3

Lipophrys pholis (Linnaeus, 1758) Family BLENNIIDAE

Shape: cuneiform to oval, sinuate to lobate margins. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: elliptic, longer than the cauda. *Cauda*: elliptic, straight, ending close to the posterior margin. *Anterior region*: peaked to double-peaked; rostrum short, broad, pointed to irregular; antirostrum short, broad, round to pointed; excisura relatively wide with a conspicuous round notch in the largest otoliths. *Posterior region*: oblique to angled.

OL/TL	OH/OL	Circularity	Rectangularity
1.5-2.0	52.2-59.5	16.5-28.1	0.3

Lipophrys trigloides (Valenciennes, 1836) Family BLENNIIDAE

Shape: oval. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: elliptic, longer than the cauda. *Cauda*: elliptic, straight, ending close to the posterior margin. *Anterior region*: peaked to double-peaked; rostrum long, broad, pointed with a round tip; antirostrum short, broad, round; excisura wide with a round, shallow to acute, deep notch. *Posterior region*: oblique.

OL/TL	OH/OL	Circularity	Rectangularity
1.7-1.9	58.1-62.4	16.6-18.8	0.2-0.3

Parablennius gattorugine (Brünnich, 1768) Family BLENNIIDAE

Shape: oval, dorsal margin sinuate. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: elliptic, longer than the cauda. *Cauda*: elliptic, straight, ending close to the posterior margin. *Anterior region*: peaked; rostrum short, broad, pointed; antirostrum short, broad, round; excisura wide with a shallow, angular notch. *Posterior region*: round to oblique.

OL/TL	OH/OL	Circularity	Rectangularity
1.8-2.3	54.2-58.1	16.6-16.8	0.3

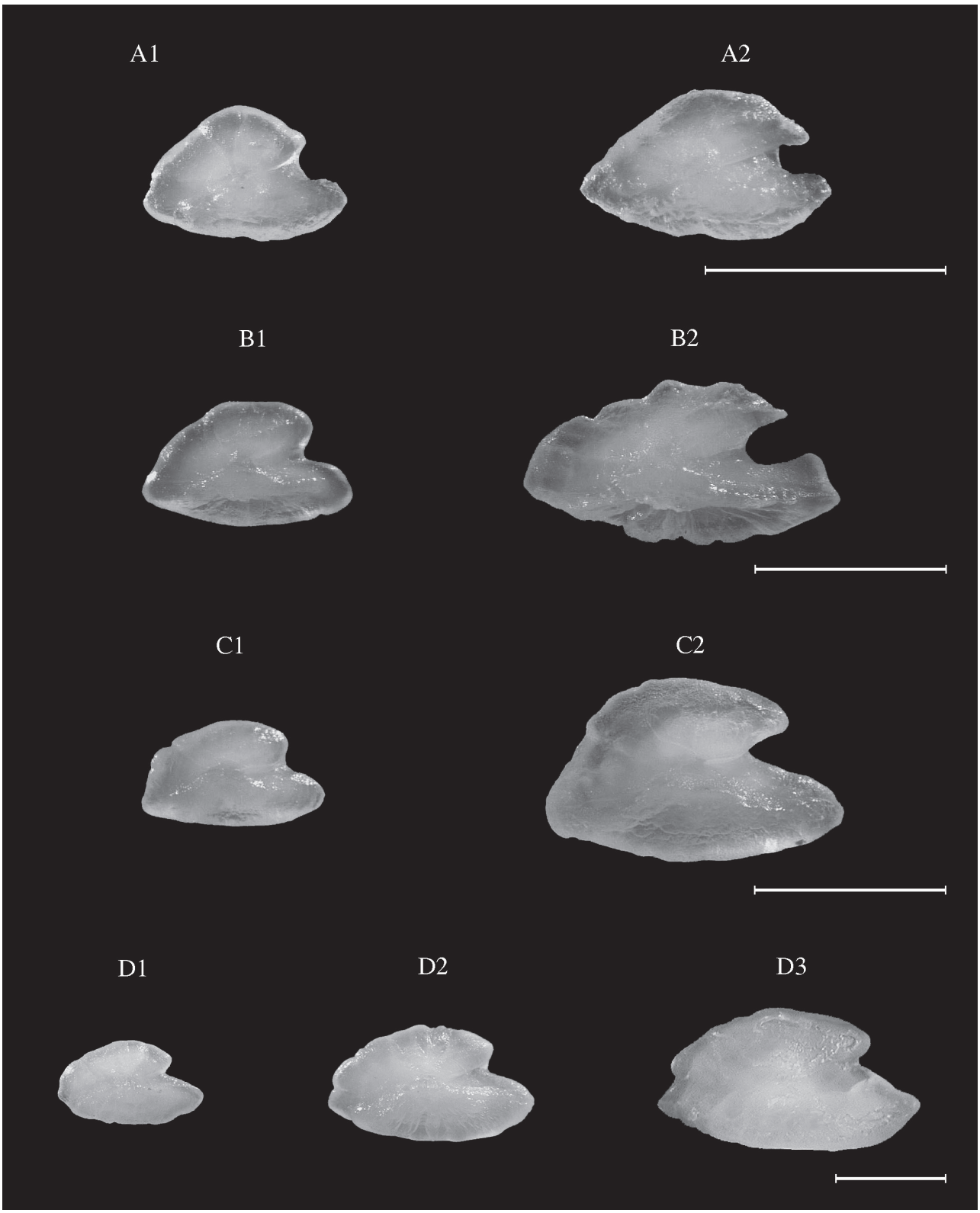

FIG. 76. – *Coryphoblennius galerita* (NEA). TL: A1, 4.2 cm; A2, 6.2 cm.
Lipophrys pholis (NEA). TL: B1, 5.2 cm; B2, 9.7 cm.
Lipophrys trigloides (NEA). TL: C1, 5.0 cm; C2, 9.2 cm.
Parablennius gattorugine. TL: D1, 5.0 cm (NEA); D2, 9.2 cm (NEA); D3, 11.5 cm (WM).
Scale bar = 1 mm.

Parablennius pilicornis (Cuvier, 1829) Family BLENNIIDAE

Shape: oval. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: elliptic, longer than the cauda. *Cauda*: oval, straight, descending, ending far from the posterior margin. *Anterior region*: peaked; rostrum short, broad, round; antirostrum short, broad, round; excisura wide with a shallow notch. *Posterior region*: angled.

OL/TL	OH/OL	Circularity	Rectangularity
2.0-2.4	51.4-59.1	15.0-16.6	0.3

Parablennius rouxi (Cocco, 1833) Family BLENNIIDAE

Shape: oval. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: elliptic, longer than the cauda. *Cauda*: oval, straight, descending, ending far from the posterior margin. *Anterior region*: peaked; rostrum short, broad, round; antirostrum poorly defined; excisura wide with a shallow notch. *Posterior region*: angled.

OL/TL	OH/OL	Circularity	Rectangularity
2.2	61.1	15.5	0.2

Parablennius tentacularis (Brünnich, 1768) Family BLENNIIDAE

Shape: elliptic. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: elliptic, longer than the cauda. *Cauda*: elliptic, straight, ending far from the posterior margin. *Anterior region*: peaked; rostrum long, broad, pointed; antirostrum poorly defined; excisura wide with a shallow notch. *Posterior region*: oblique.

OL/TL	OH/OL	Circularity	Rectangularity
2.3	53.9	16.9	0.3

Scartella cristata (Linnaeus, 1758) Family BLENNIIDAE

Shape: elliptic. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: elliptic, longer than the cauda. *Cauda*: elliptic, straight, ending far from the posterior margin. *Anterior region*: peaked; rostrum long, broad, round; antirostrum poorly defined; excisura wide with or without a shallow notch. *Posterior region*: round-oblique to oblique.

OL/TL	OH/OL	Circularity	Rectangularity
1.6-1.8	56.0-64.7	14.3-15.5	0.2-0.3

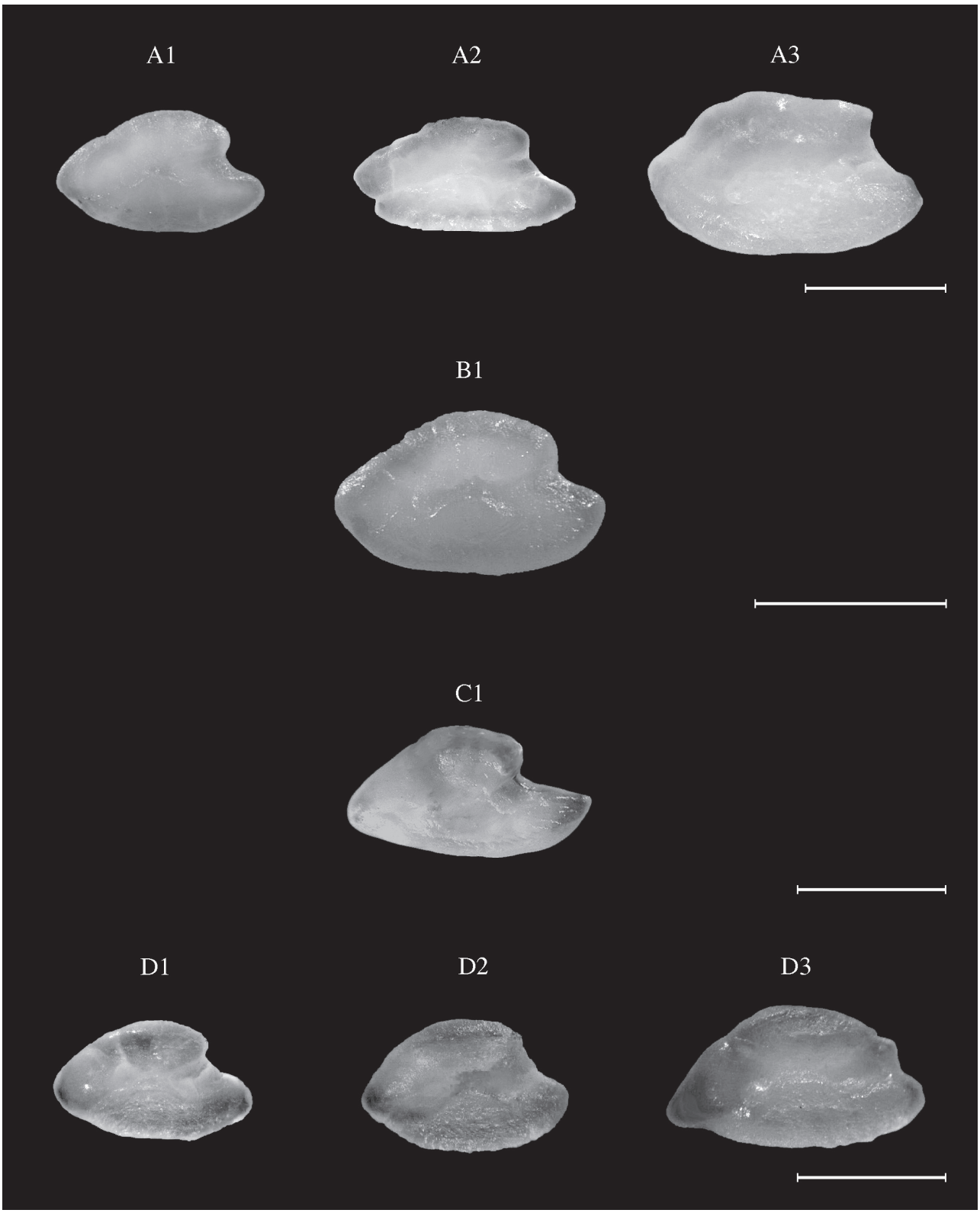

FIG. 77. – *Parablennius pilicornis.* TL: A1, 6.3 cm (NEA); A2, 7.9 cm (WM); A3, 8.9 cm (WM).
Parablennius rouxi (NEA). TL: B1, 6.4 cm.
Parablennius tentacularis (WM). TL: C1, 7.0 cm.
Scartella cristata (WM). TL: D1, 8.2 cm; D2, 8.5 cm; D3, 9.7 cm.
Scale bar = 1 mm.

Lepadogaster purpurea (Bonnaterre, 1788) FAMILY GOBIESOCIDAE

Shape: oval to elliptic. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: tubular, progressively narrower to the opening, as wide and as long as the cauda. *Cauda*: round-oval, straight, ending far from the posterior margin. *Anterior region*: round to lanceolated; rostrum short, broad, pointed; antirostrum absent or poorly defined; excisura narrow, with a shallow notch in small otoltihs. *Posterior region*: round to round-oblique.

OL/TL	OH/OL	Circularity	Rectangularity
1.5-1.6	57.0-61.8	15.5-15.8	0.2-0.3

Callionymus lyra Linnaeus, 1758 Family CALLIONYMIDAE

Shape: approximately triangular, dorsal margin round, ventral margin almost straight or slightly concave. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: tubular, ascending, longer than the cauda. *Cauda*: oval, more dorsal than the ostium, ending in the middle of the otolith. *Anterior region*: peaked; rostrum short, broad, pointed; antirostrum short, broad, round; excisura relatively narrow with a shallow, acute notch. *Posterior region*: pointed.

OL/TL	OH/OL	Circularity	Rectangularity
1.4-2.1	30.4-44.5	18.9-24.9	0.4-0.5

Callionymus maculatus Rafinisque, 1810 Family CALLIONYMIDAE

Shape: approximately triangular, dorsal margin round, ventral margin almost straight or slightly concave. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, ascending, longer than the cauda. *Cauda*: oval, more dorsal than the ostium, ending in the middle of the otolith. *Anterior region*: peaked; rostrum short, broad, pointed or round; antirostrum short, broad, round; excisura wide with or without a shallow notch. *Posterior region*: pointed.

OL/TL	OH/OL	Circularity	Rectangularity
1.9-2.7	47.8-49.8	12.0-17.6	0.3-0.4

Callionymus risso Lesueur, 1814 Family CALLIONYMIDAE

Shape: approximately triangular, dorsal margin round, ventral margin almost straight or slightly concave. *Sulcus acusticus*: heterosulcoid, ostial, median, ascending. *Ostium*: tubular, slightly bent, ascending, longer than the cauda. *Cauda*: oval, slightly curved at its origin, more dorsal than the ostium, ending in the middle of the otolith. *Anterior region*: peaked; rostrum short, broad, pointed; antirostrum slightly smaller than the rostrum, broad, pointed; excisura relatively narrow with a shallow notch. *Posterior region*: pointed.

OL/TL	OH/OL	Circularity	Rectangularity
1.9-2.8	48.0-50.8	16.7-19.6	0.3-0.4

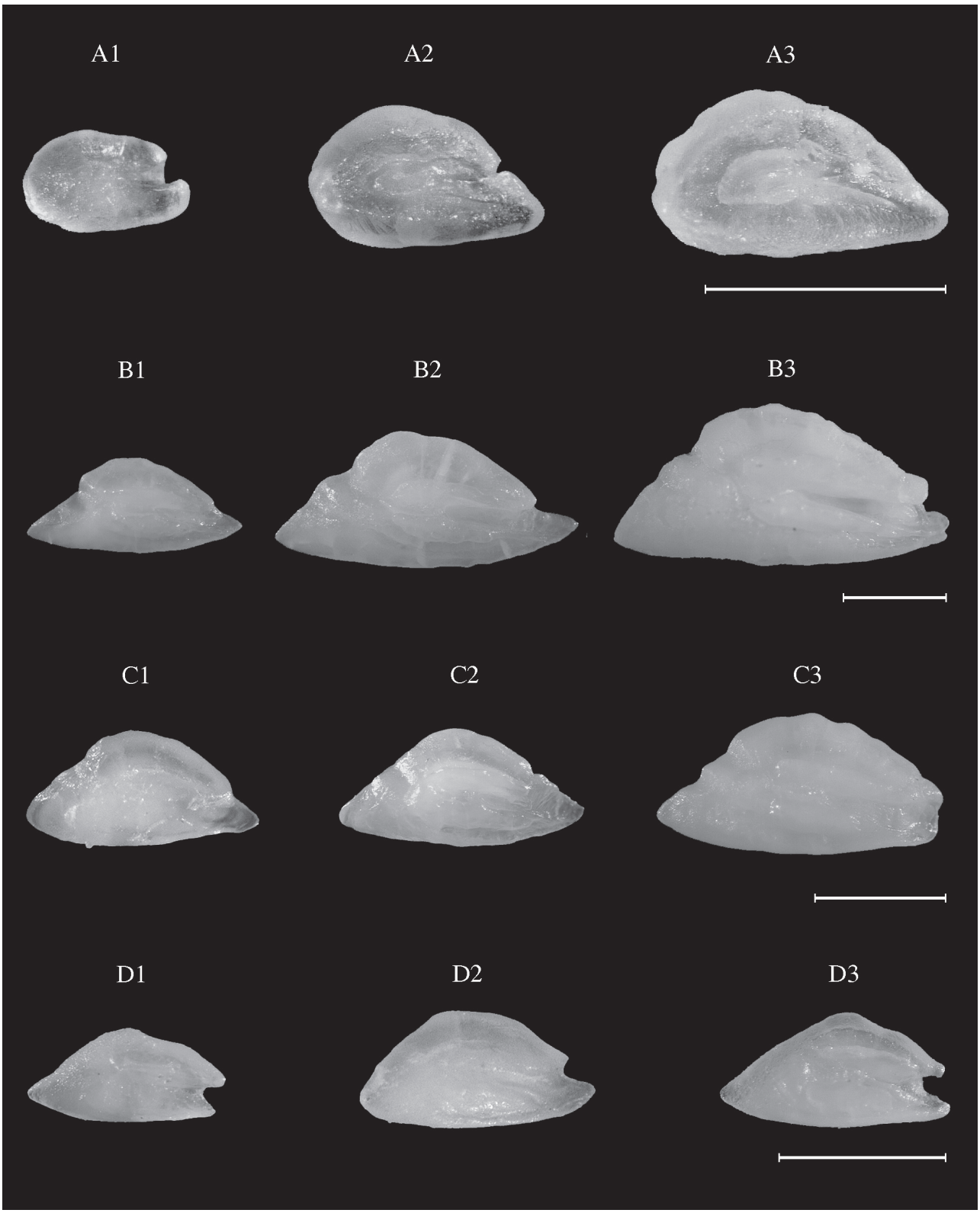

FIG. 78. – *Lepadogaster purpurea* (NEA). TL: A1, 4.6 cm; A2, 6.0 cm; A3, 7.8 cm.
Callionymus lyra (NEA). TL: B1, 10.1 cm; B2, 16.0 cm; B3, 23.5 cm.
Callionymus maculatus. TL: C1, 7.5 cm (WM); C2, 9.6 cm (NEA); C3, 11.3 cm (NEA).
Callionymus risso. TL: D1, 6.3 cm (NEA); D2, 6.5 cm (WM); D3, 7.2 cm (NEA).
Scale bar = 1 mm.

Synchiropus phaeton (Günther, 1861) Family CALLIONYMIDAE

Shape: approximately triangular, dorsal margin round and lobed, ventral margin almost straight or slightly concave. *Sulcus acusticus*: heterosulcoid, ostial. *Ostium*: tubular, funnel-like, ascending, longer than the cauda. *Cauda*: oval, straight more dorsal than the ostium, ending in the middle of the otolith. *Anterior region*: peaked; rostrum short, broad, sharp-end upward; antirostrum slightly smaller than the rostrum, broad, pointed; excisura relatively narrow with a shallow notch. *Posterior region*: pointed or sharp-ended.

OL/TL	OH/OL	Circularity	Rectangularity
1.5-2.3	34.7-47.8	19.4-28.4	0.4-0.5

Aphia minuta (Rissso, 1810) Family GOBIIDAE

Shape: squared. *Sulcus acusticus*: heterosulcoid, mesial, median, ascending. *Ostium*: round-oval, as long as the cauda but wider, ending far from the anterior margin. *Cauda*: round to oval, ending half way to the posterior margin. *Anterior region*: flattened-round, convex. *Posterior region*: flattened-round, slightly concave.

OL/TL	OH/OL	Circularity	Rectangularity
1.8-2.0	109.9-120.3	13.6-14.3	-0.1-0.0

Deltentosteus quadrimaculatus (Valenciennes, 1837) Family GOBIIDAE

Shape: squared to slightly rectangular. *Sulcus acusticus*: heterosulcoid, mesial, supramedian, ascending. *Ostium*: round to oval, shorter than the cauda in the larger otoliths, but wider, ending far from the anterior margin. *Cauda*: round to oval, ending far from the posterior margin. *Anterior region*: round to irregular with two slight but unequal lobes separated by a shallow notch and clearly inframedian notch, the ventral lobe is smaller but more prominent in the larger otoliths. *Posterior region*: round to irregular with a shallow asymmetric notch in the middle of the margin that defines a large dorsal lobe.

OL/TL	OH/OL	Circularity	Rectangularity
4.2-4.5	76.8-84.9	13.6-14.2	0.1

Gobius bucchichi Steindachner, 1870 Family GOBIIDAE

Shape: rhomboidal. *Sulcus acusticus*: homosulcoid, mesial, supramedian, ascending. *Ostium*: round to oval, as long as the cauda, ending far from the anterior margin. *Cauda*: round to oval, ending far from the posterior margin. *Anterior region*: oblique, with a sharply pointed ventral. *Posterior region*: oblique to irregular, with a middle shallow notch separating a short, round ventral lobe, and a long, sharply pointed dorsal lobe.

OL/TL	OH/OL	Circularity	Rectangularity
3.6-3.7	68.3-71.7	14.6-15.7	0.2

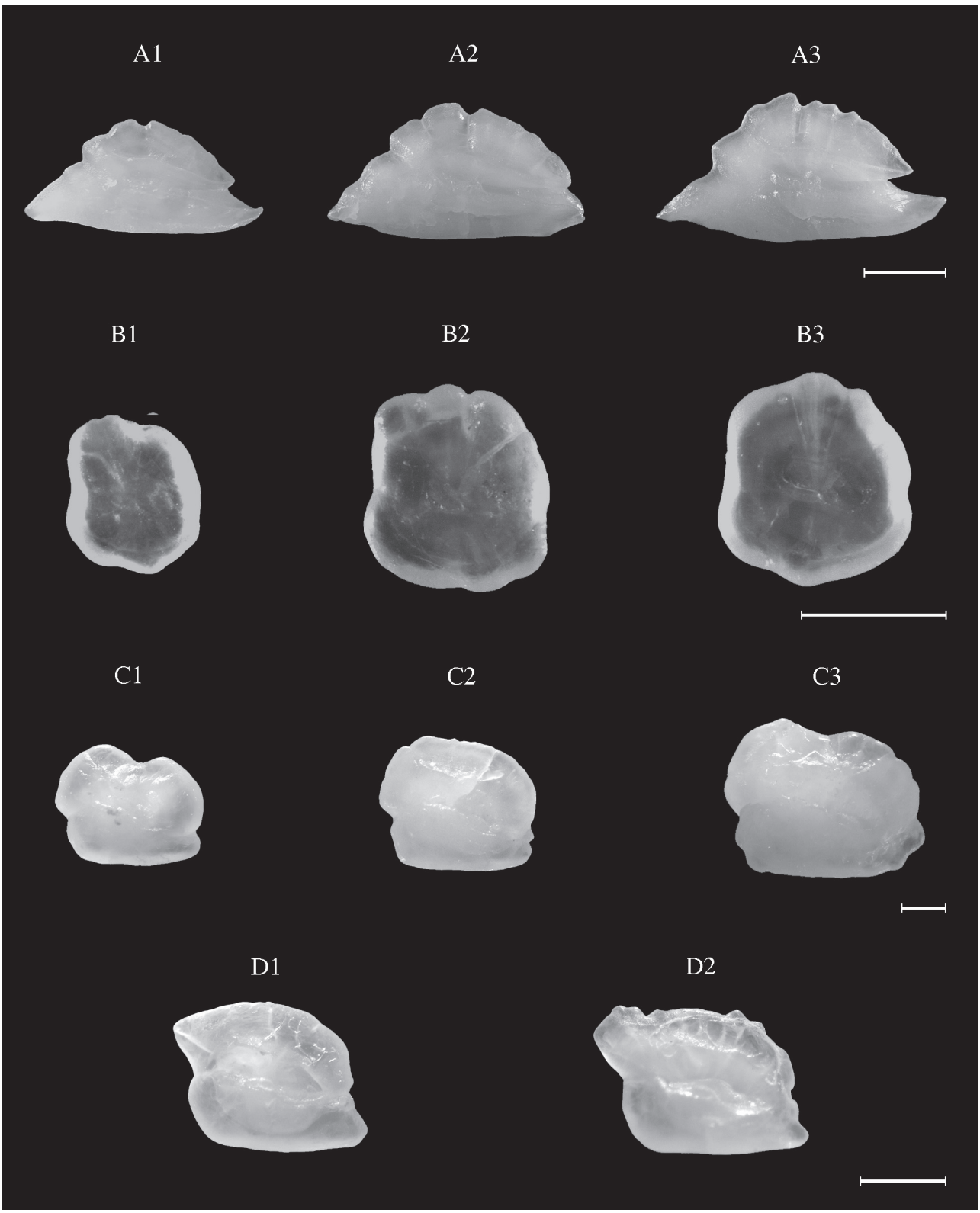

FIG. 79. – *Synchiropus phaeton.* TL: A1, 12.5 cm (WM); A2, 17.6 cm (NEA); A3, 23.4 cm (NEA).
Aphia minuta (NEA). TL: B1, 5.0 cm; B2, 6.5 cm; B3, 7.7 cm.
Deltentosteus quadrimaculatus (WM). TL: C1, 7.5 cm; C2, 8.6 cm; C3, 10.2 cm.
Gobius bucchichi (WM). TL: D1, 7.0 cm; D2, 7.5 cm.
Scale bar = 1 mm.

Gobius cruentatus Gmelin, 1789 Family GOBIIDAE

Shape: approximately square to slightly rectangular, with one anterior ventral and one posterior dorsal projection. *Sulcus acusticus*: heterosulocid, mesial, supramedian, ascending. *Ostium*: round-oval, as long as the cauda, but wider, ending far from the anterior margin. *Cauda*: round-oval, ending far from the posterior margin. *Anterior region*: flattened, slightly concave, with a sharply pointed ventral angle. *Posterior region*: flattened ventrally, with a sharply pointed or blunt conspicuous projection in the dorsal region.

OL/TL	OH/OL	Circularity	Rectangularity
3.6-4.2	68.8-73.2	15.2-16.1	0.2

Gobius niger Linnaeus, 1758 Family GOBIIDAE

Shape: approximately square to slightly rectangular, with one anterior ventral and one posterior dorsal projection, dorsal margin round, slightly dentate. *Sulcus acusticus*: heterosulcoid, mesial, median, ascending. *Ostium*: round-oval, as long as the cauda, but wider, ending far from the anterior margin. *Cauda*: round-oval, ending far from the posterior margin. *Anterior region*: flattened, slightly concave, a round to pointed protuberance in the ventral angle. *Posterior region*: with two lobes separated by a median shallow notch, dorsal lobe more prominent pointed or round.

OL/TL	OH/OL	Circularity	Rectangularity
3.2-4.5	72.7-85.6	10.8-15.7	0.1

Gobius paganellus Linnaeus, 1758 Family GOBIIDAE

Shape: approximately square to slightly rectangular, with one anterior ventral and one posterior dorsal projection, dorsal and ventral margins flat. *Sulcus acusticus*: heterosulcoid, mesial, median, ascending. *Ostium*: round-oval, as long as the cauda, but wider, ending far from the anterior margin. *Cauda*: round-oval, ending far from the posterior margin. *Anterior region*: flattened dorsally, with a round to pointed projection in the ventral half. *Posterior region*: flattened ventrally, with a round projection in the dorsal third.

OL/TL	OH/OL	Circularity	Rectangularity
2.9	74.7	16.7	0.2

Lesueurigobius friesii (Malm, 1874) Family GOBIIDAE

Shape: square or slightly discoidal. *Sulcus acusticus*: heterosulcoid, mesial, median, slightly ascending. *Ostium*: round-oval, considerably longer and wider than the cauda, ending far from the anterior margin. *Cauda*: round-oval, ending far from the posterior margin. *Anterior region*: with a shallow, inframedian notch that defines two lobes, of which the dorsal is larger. *Posterior region*: with two lobes separated by an angular median shallow notch.

OL/TL	OH/OL	Circularity	Rectangularity
4.0-4.6	87.6-88.0	13.3-14.5	0.1

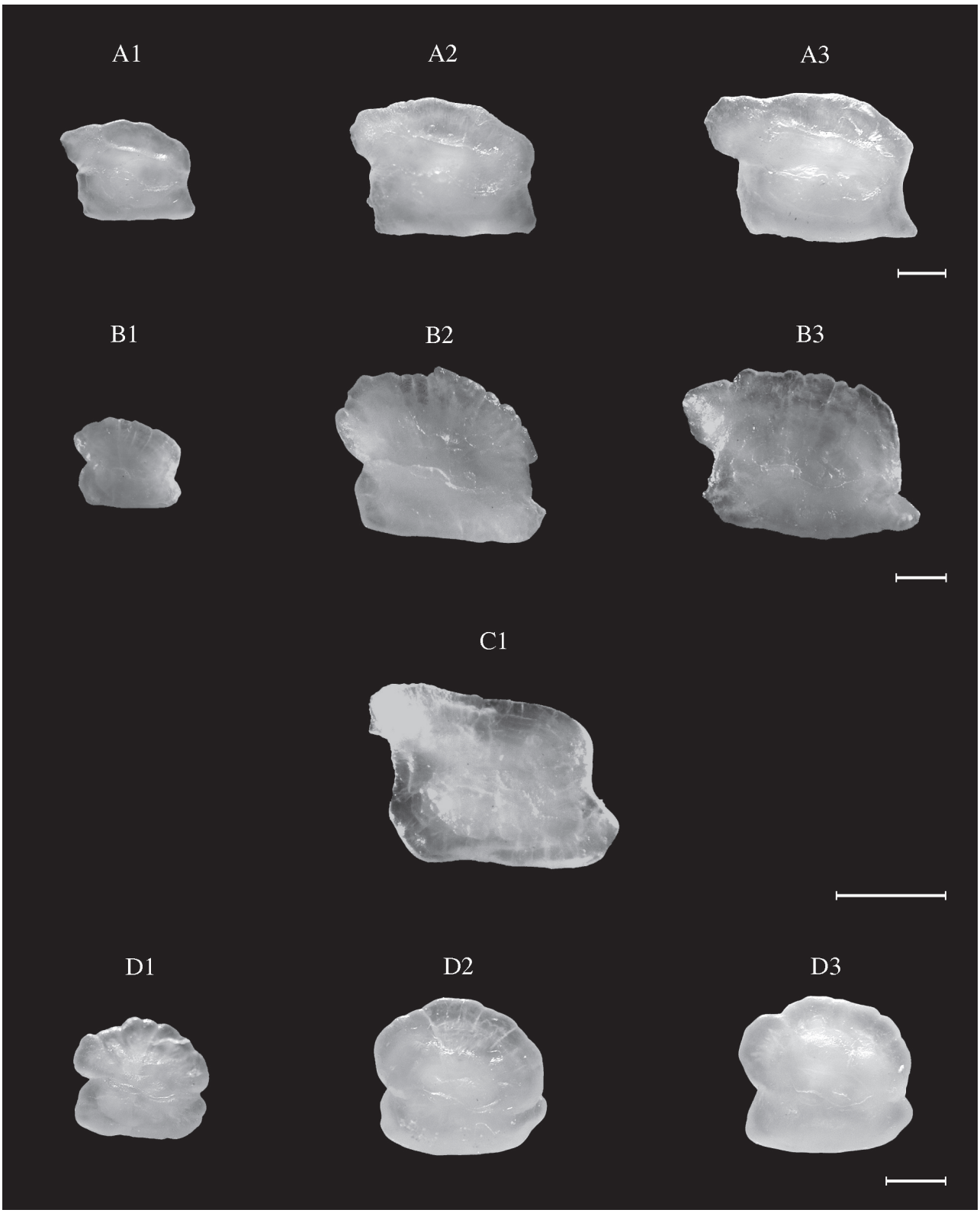

FIG. 80. – *Gobius cruentatus* (WM). TL: A1, 7.5 cm; A2, 11.0 cm; A3, 13.5 cm.
Gobius niger. TL: B1, 6.0 cm (NEA); B2, 10.0 cm (WM); B3, 14.5 cm (NEA).
Gobius paganellus (NEA). TL: C1, 7.9 cm.
Lesueurigobius friesii (WM). TL: D1, 5.0 cm; D2, 6.5 cm; D3, 7.5 cm.
Scale bar = 1 mm.

Lesueurigobius sanzoi (de Buen, 1918) Family GOBIIDAE

Shape: discoidal with a dorsal margin slightly rounder than the ventral. *Sulcus acusticus*: heterosulcoid, mesial, median, slightly ascending. *Ostium*: round-oval, longer and wider than the cauda, ending far from the anterior margin. *Cauda*: round-oval, ending far from the posterior margin. *Anterior region*: round. *Posterior region*: round, a shallow, round or angular, median notch.

OL/TL	OH/OL	Circularity	Rectangularity
3.4-4.1	96.3-111.0	14.0-14.6	-0.1-0.0

Lesueurigobius suerii (Pallas, 1770) Family GOBIIDAE

Shape: squared, with slightly lobed margins. *Sulcus acusticus*: heterosulcoid, mesial, median, slightly ascending. *Ostium*: round-oval, longer and wider than the cauda, ending far from the anterior margin. *Cauda*: round-oval, ending far from the posterior margin. *Anterior and posterior regions*: each with two well defined lobes separated by a small notch in the middle.

OL/TL	OH/OL	Circularity	Rectangularity
4.6-4.7	87.6-92.1	14.7	0.0-0.1

Odondebuenia balearica (Pellegrin and Fage, 1907) Family GOBIIDAE

Shape: approximately rectangular, with flat ventral margin. *Sulcus acusticus*: heterosulcoid, mesial, median, slightly ascending. *Ostium*: round-oval, as long as the cauda, ending far from the anterior margin. *Cauda*: round-oval, ending far from the posterior margin. *Anterior region*: flattened, slightly concave. *Posterior region*: flattened, slightly concave with a sharply pointed dorsal angle.

OL/TL	OH/OL	Circularity	Rectangularity
4.6	72.6	14.6	0.2

Pomatoschistus marmoratus (Risso, 1810) Family GOBIIDAE

Shape: discoidal with a dorsal margin slightly rounder than the ventral. *Sulcus acusticus*: heterosulcoid, mesial, median, ascending. *Ostium*: round-oval, longer and wider than the cauda, ending far from the anterior margin. *Cauda*: round-oval, ending far from the posterior margin. *Anterior region*: round. *Posterior region*: flattened to round, convex.

OL/TL	OH/OL	Circularity	Rectangularity
2.6-3.0	94.1-95.4	12.9-13.1	0.0

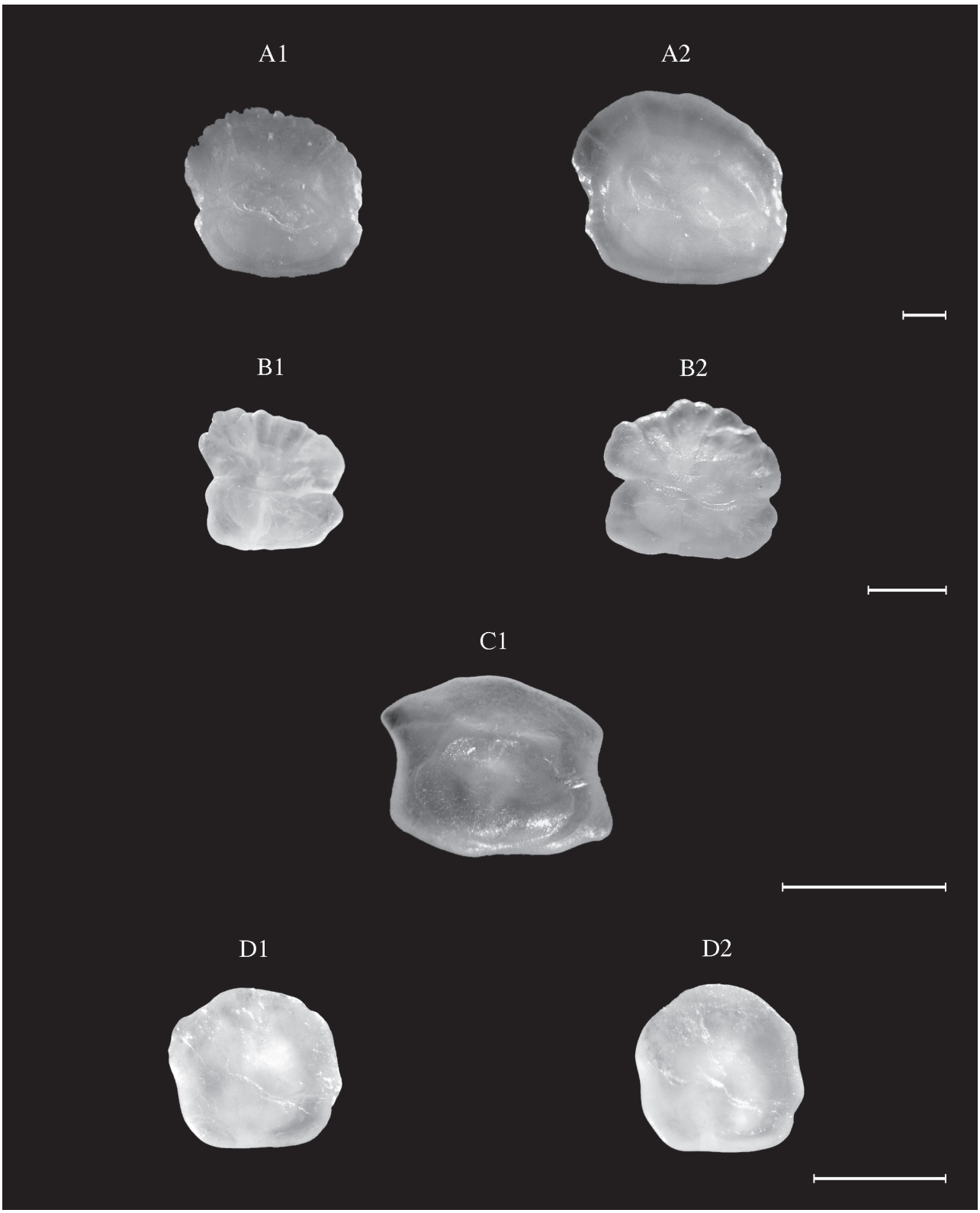

FIG. 81. – *Lesueurigobius sanzoi* (NEA). TL: A1, 9.9 cm; A2, 13.1 cm.
Lesueurigobius suerii (WM). TL: B1, 4.5 cm; B2, 5.0 cm
Odondebuenia balearica (WM). TL: C1, 3.4 cm;
Pomatoschistus marmoratus (WM). TL: D1, 4.5 cm; D2, 5.0 cm.
Scale bar = 1 mm.

Pseudaphya ferreri (de Buen, and Fage, 1908) Family Gobiidae

Shape: discoidal, wider than longer, with a dorsal margin slightly rounder than the ventral. *Sulcus acusticus*: heterosulcoid, mesial, median, slightly ascending. *Ostium*: round-oval, as long as the cauda, ending far from the anterior margin. *Cauda*: round-oval, ending far from the posterior margin. *Anterior region*: round. *Posterior region*: flattened, slightly concave.

OL/TL	OH/OL	Circularity	Rectangularity
2.8	102.2	13.09	0.0

Sphyraena sphyraena (Linnaeus, 1758) Family Sphyraenidae

Shape: spindle-shaped. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: tubular, straight or curved, slightly flexed posteriorly, ending far from the posterior margin. *Anterior region*: peaked; rostrum short, broad, pointed, tip slightly curved to the dorsal region; antirostrum poorly defined; excisura wide without a notch. *Posterior region*: oblique.

OL/TL	OH/OL	Circularity	Rectangularity
2.9-3.1	30.4-32.3	21.7-21.9	0.5

Sphyraena viridensis Cuvier, 1829 Family Sphyraenidae

Shape: spindle-shaped. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: tubular, curved, strongly flexed from the middle region, ending far from the posterior margin. *Anterior region*: peaked; rostrum short, broad, pointed (rounder than in *S. sphyraena*); antirostrum poorly defined or short, narrow, pointed; excisura wide, with or without an acute, shallow notch. *Posterior region*: oblique-round to oblique-angled.

OL/TL	OH/OL	Circularity	Rectangularity
2.0-2.4	31.2-33.2	21.0	0.5

Lepidocybium flavobrunneum (Smith, 1843) Family Gempylidae

Shape: approximately trapezoidal, lobate margins. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: elliptic, as long as the cauda. *Cauda*: elliptic, ending close to the posterior margin. *Anterior region*: peaked; rostrum long, broad, pointed; antirostrum absent; excisura wide without a notch. *Posterior region*: oblique.

OL/TL	OH/OL	Circularity	Rectangularity
1.0	36.5	22.9	0.5

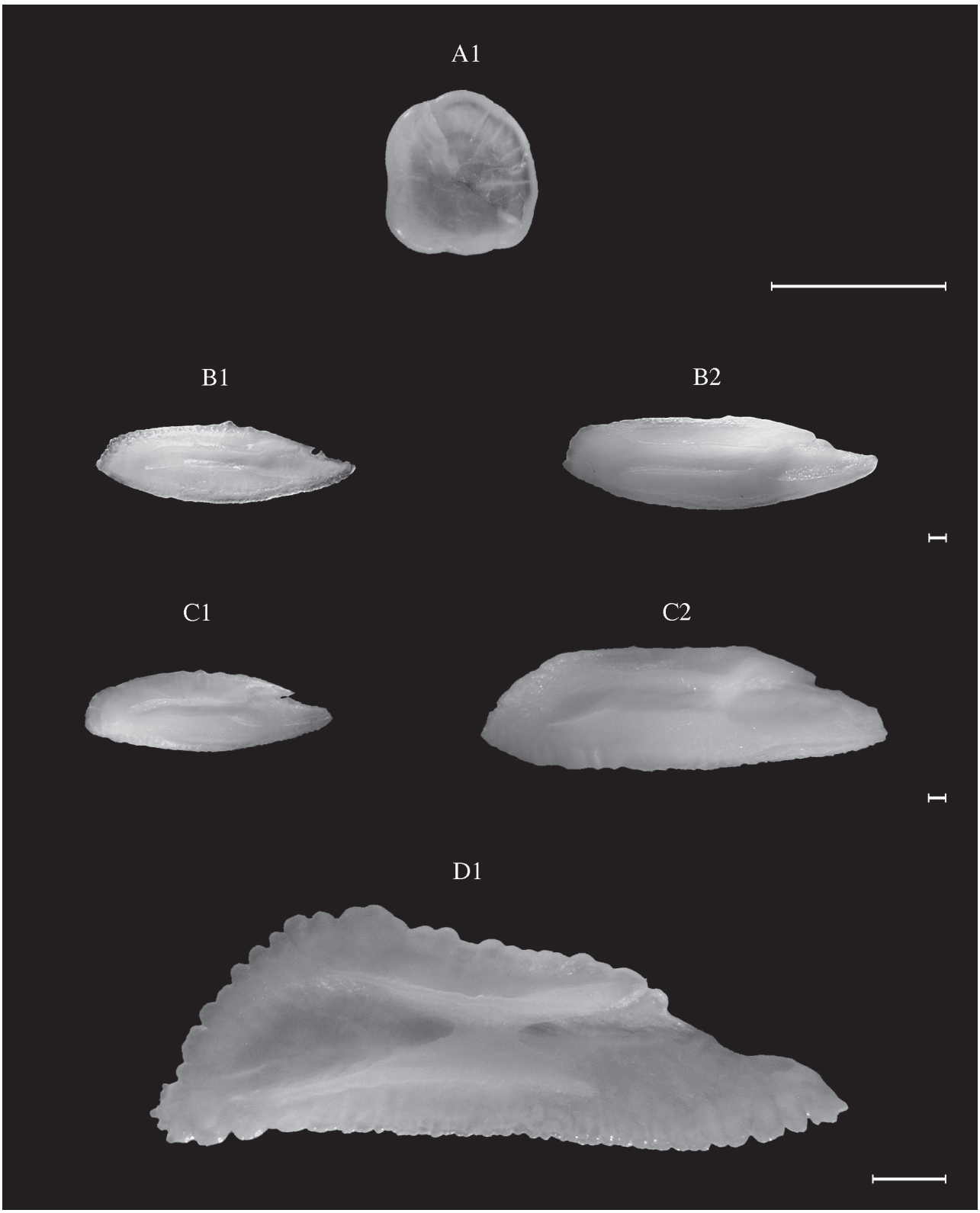

FIG. 82. – *Pseudaphya ferreri* (WM). TL: A1, 3.2 cm.
Sphyraena sphyraena (WM). TL: B1, 32.7 cm; B2, 42.7 cm.
Sphyraena viridensis (CEA). TL: C1, 57.0 cm; C2, 108.0 cm.
Lepidocybium flavobrunneum (CEA). TL: D1, 94.0 cm.
Scale bar = 1 mm.

Promethichthys prometheus (Cuvier, 1832) Family GEMPYLIDAE

Shape: lanceolated, dentate margins. *Sulcus acusticus*: pseudo-archaesulcoid (it may appear heterosulcoid), ostial, median. *Ostium and cauda*: not clearly differentiated, inferior crista of ostium ending at the rostrum tip, cauda straight, ending close to the posterior margin. *Anterior region*: peaked; rostrum long, moderately narrow, lanceolated; antirostrum short, broad, round to pointed; excisura very wide with a deep, acute notch. *Posterior region*: round to irregular, with a clear notch.

OL/TL	OH/OL	Circularity	Rectangularity
1.8	45.4-50.1	22.5-23.7	0.3-0.4

Aphanopus carbo Lowe, 1839 Family TRICHIURIDAE

Shape: elliptic to oblong, ventral margin sinuate to crenate. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: tubular, straight, ending half way to the posterior margin. *Anterior region*: peaked; rostrum short, broad, pointed; antirostrum absent or short, narrow, pointed; excisura wide with or without a deep, acute notch. *Posterior region*: round.

OL/TL	OH/OL	Circularity	Rectangularity
0.8-0.9	43.5-45.7	17.5-18.8	0.4

Benthodesmus simonyi (Steindachner, 1891) Family TRICHIURIDAE

Shape: elliptic, anterior-dorsal margin may present one deep indentation. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: tubular, straight, ending half way to the posterior margin. *Anterior region*: peaked; rostrum long, broad, pointed; antirostrum poorly defined; excisura wide without a notch. *Posterior region*: round to irregular.

OL/TL	OH/OL	Circularity	Rectangularity
0.7-0.8	35.3-37.7	18.7-19.6	0.5

Lepidopus caudatus (Euphrasen, 1788) Family TRICHIURIDAE

Shape: triangular-elongated. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: tubular, straight, ending half way to the posterior margin. *Anterior region*: peaked; rostrum long, narrow, pointed; antirostrum absent; excisura narrow without a notch. *Posterior region*: oblique.

OL/TL	OH/OL	Circularity	Rectangularity
0.5-1.2	35.7-36.6	19.6-21.4	0.5

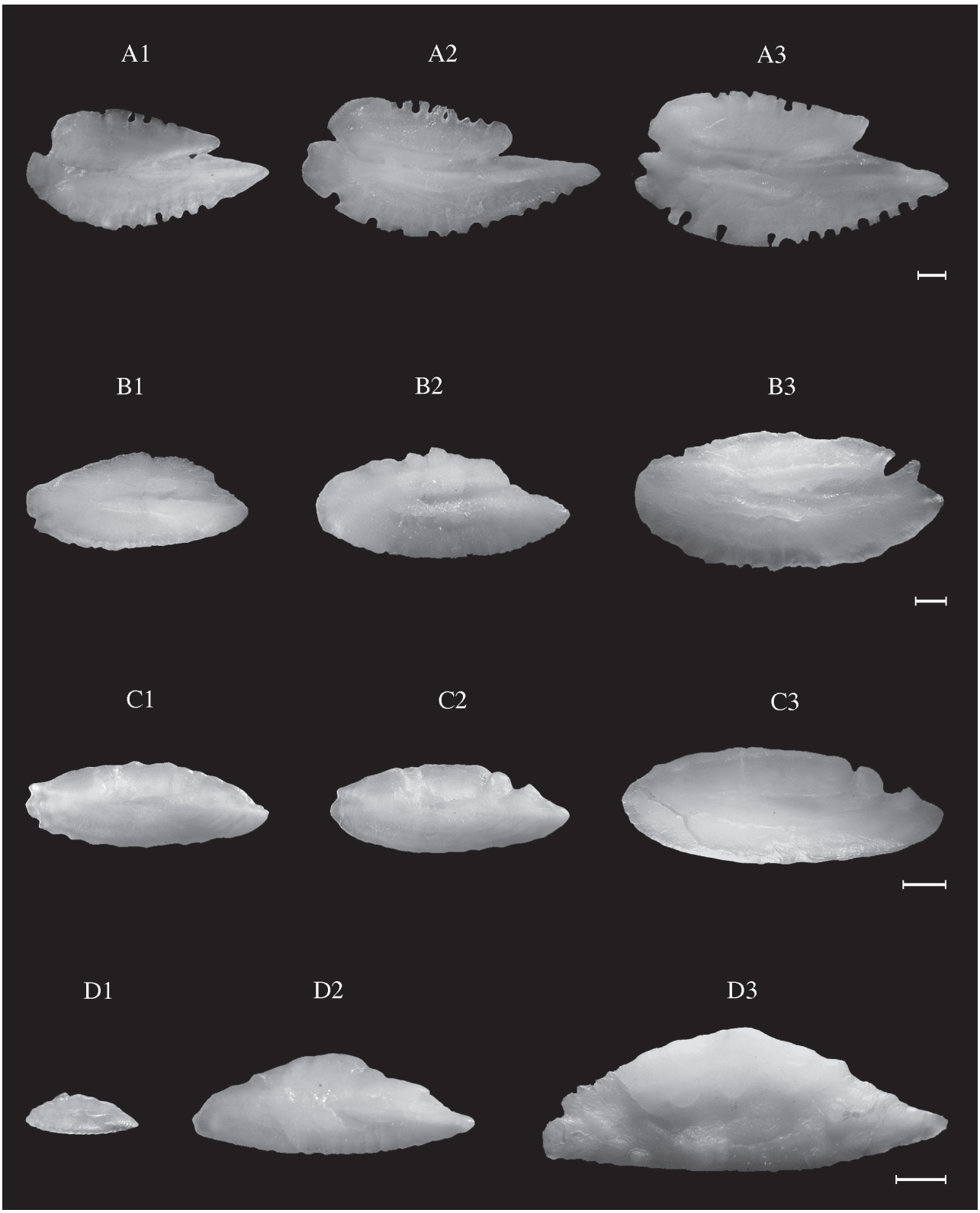

FIG. 83. – *Promethichthys prometheus* (CEA). TL: A1, 47.0 cm; A2, 58.3 cm; A3, 59.8 cm.
Aphanopus carbo. TL: B1, 86.9 cm (CEA); B2, 103.3 cm (NEA); B3, 112.5 cm (CEA).
Benthodesmus simonyi. TL: C1, 67.9 cm (NEA); C2, 83.0 cm (NEA); C3, 103.9 cm (CEA).
Lepidopus caudatus. TL: D1, 19.0 cm (WM); D2, 76.4 cm (NEA); D3, 152.9 cm (CEA).
Scale bar = 1 mm.

Euthynnus alletteratus (Rafinesque, 1810) Family SCOMBRIDAE

Shape: oblong, ventral margin serrate to irregular, dorsal-posterior margin more developed. *Sulcus acusticus*: heterosulcoid, ostial, median, deep, dorsal-ridge well developed. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: elliptic, ending close to the posterior margin. *Anterior region*: peaked to irregular; rostrum long, broad, irregular; antirostrum short, narrow, round; excisura wide without a notch. *Posterior region*: angled.

OL/FL	OH/OL	Circularity	Rectangularity
0.9	37.2	22.1	0.5

Katsuwonus pelamis (Linnaeus, 1758) Family SCOMBRIDAE

Shape: rectangular, ventral and anterior margins sharply serrate, posterior-dorsal margin well developed. *Sulcus acusticus*: heterosulcoid, ostial may appear ostio-caudal as the posterior wall erodes with growth, median, dorsal ridge well developed. *Ostium*: funnel-like, as long as the cauda. *Cauda*: elliptic, ending very close to the posterior margin. *Anterior region*: round to irregular; rostrum long, broad, round; antirostrum short, narrow, pointed; excisura wide with an indentation-shaped notch. *Posterior region*: irregular to oblique.

OL/FL	OH/OL	Circularity	Rectangularity
0.9-1.1	41.2-42.3	23.9-24.3	0.4

Sarda sarda (Bloch, 1793) Family SCOMBRIDAE

Shape: triangular, margins crenate to dentate. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, longer than the cauda. *Cauda*: elliptic, ending very close to the posterior margin. *Anterior region*: lanceolated; rostrum long, narrow, sharply pointed; antirostrum poorly defined or short, narrow, pointed; excisura wide with or without an acute notch. *Posterior region*: oblique to irregular.

OL/FL	OH/OL	Circularity	Rectangularity
1.2-1.4	32.6-37.1	25.0-29.9	0.5

Scomber colias Gmelin, 1789 Family SCOMBRIDAE

Shape: approximately rectangular, with a deep mid-dorsal concavity *Sulcus acusticus*: heterosulcoid, ostial, with well developed ventral and dorsal ridges, median. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: tubular, curved, slightly flexed tip, progressively wider posteriorly, ending close to the posterior margin. *Anterior region*: peaked; rostrum short, narrow, round to pointed, shorter or similar to the antirostrum in size; antirostrum long, broad, round to pointed; colliculum ostii forms a long triangular, pointed anterior expansion that is longer than both the rostrum and antirostrum and becomes the anterior most extreme of the otolith; excisura wide with a deep, acute notch. *Posterior region*: flattened or oblique.

OL/FL	OH/OL	Circularity	Rectangularity
1.3-1.8	32.0-42.3	21.5-27.8	0.4-0.5

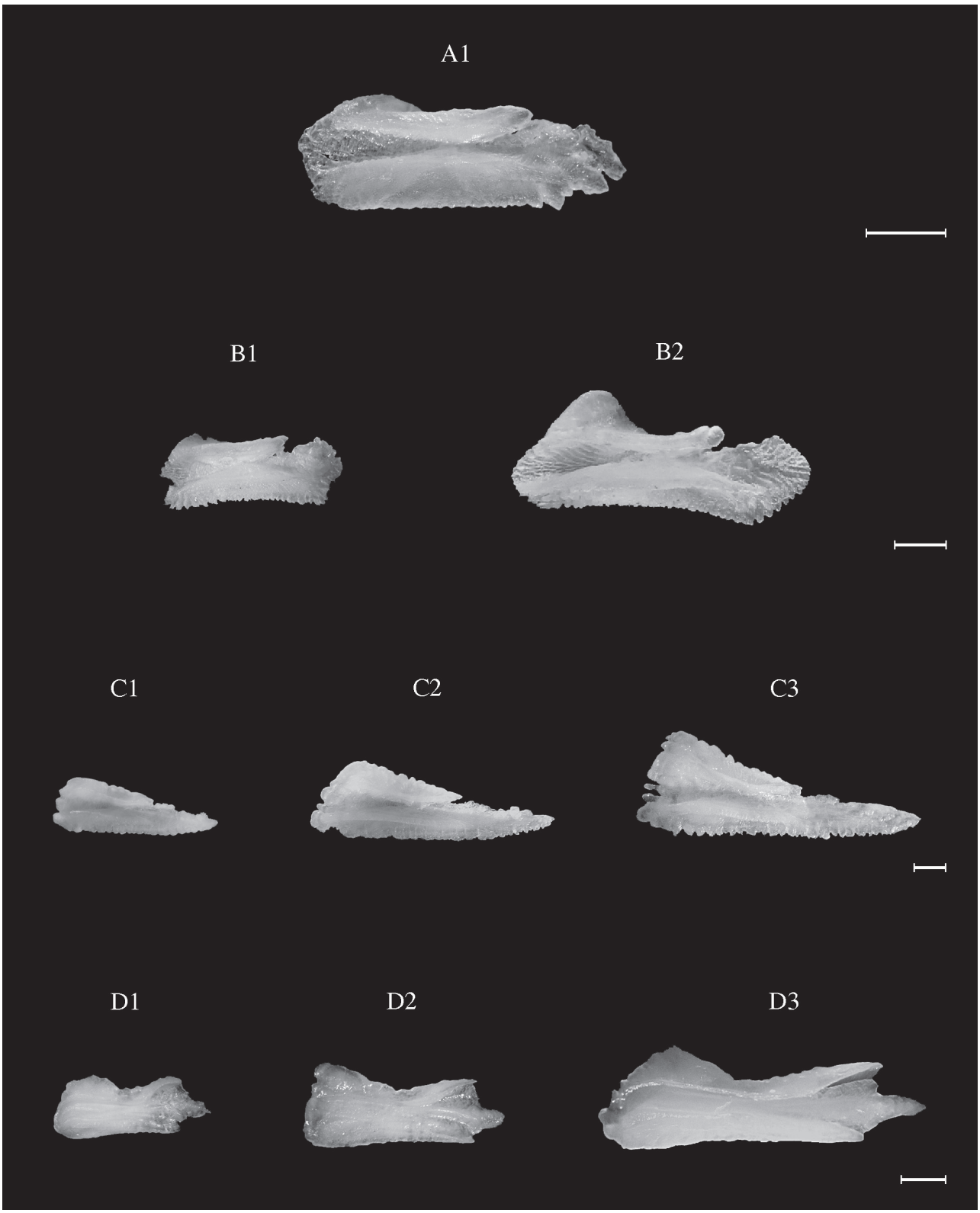

FIG. 84. – *Euthynnus alletteratus* (WM). FL: A1, 44.0 cm.
Katsuwonus pelamis (CEA). FL: B1, 41.2 cm.
Sarda sarda (WM). FL: C1, 36.0 cm; C2, 59.0 cm; C3, 65.0 cm.
Scomber colias. FL: D1, 18.6 cm (NEA); D2, 30.9 cm (CEA); D3, 40.5 cm (WM).
Scale bar = 1 mm.

Scomber scombrus Linnaeus, 1758 Family SCOMBRIDAE

Shape: lanceolated. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, shorter or similar to the cauda in size. *Cauda*: tubular, curved, strongly flexed posteriorly, ending very close to the posterior-ventral margin. *Anterior region*: peaked; rostrum short to long, relatively narrow, pointed to lanceolated; antirostrum short, broad, round or pointed; excisura wide with an acute, deep notch. *Posterior region*: oblique.

OL/FL	OH/OL	Circularity	Rectangularity
1.1-1.8	36.2-44.1	21.2-25.7	0.4-0.5

Thunnus alalunga (Bonnaterre, 1788) Family SCOMBRIDAE

Shape: approximately lanceolated, serrate margins, especially the ventral margin. *Sulcus acusticus*: heterosulcoid, ostial, median, deep, with a very developed dorsal ridge. *Ostium*: funnel-like, shorter than or similar to the cauda in size. *Cauda*: tubular, straight, wider posteriorly, ending close to the posterior margin. *Anterior region*: peaked; rostrum elongated, narrow, pointed, dorsally flexed; antirostrum short, narrow, pointed, dorsally flexed; excisura very wide with a dentate notch. *Posterior region*: oblique.

OL/FL	OH/OL	Circularity	Rectangularity
0.9	29.7	29.2	0.5

Thunnus obesus (Lowe, 1839) Family SCOMBRIDAE

Shape: approximately lanceolated, with serrate margins, especially the ventral margin. *Sulcus acusticus*: heterosulcoid, ostial, median, deep, with a well developed dorsal ridge. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: tubular, straight, slightly wider posteriorly, ending close to the posterior margin. *Anterior region*: peaked; rostrum lanceolated, narrow, sharply pointed, dorsally flexed; antirostrum absent or narrow, short, pointed, dorsally flexed; excisura very wide without a notch. *Posterior region*: oblique.

OL/FL	OH/OL	Circularity	Rectangularity
1.2-1.3	33.1-34.7	22.4-25.0	0.5

Thunnus thynnus (Linnaeus, 1758) Family SCOMBRIDAE

Shape: approximately lanceolated, serrate margins, especially the ventral margin. *Sulcus acusticus*: heterosulcoid, ostial, median, deep, with a well developed dorsal ridge. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: tubular, straight, ending close to the posterior margin. *Anterior region*: peaked; rostrum lanceolated, narrow, pointed, flexed dorsally; antirostrum absent or narrow, short, pointed; excisura very wide without a notch. *Posterior region*: oblique.

OL/FL	OH/OL	Circularity	Rectangularity
-	27.7-30.1	24.4-25.7	0.5-0.6

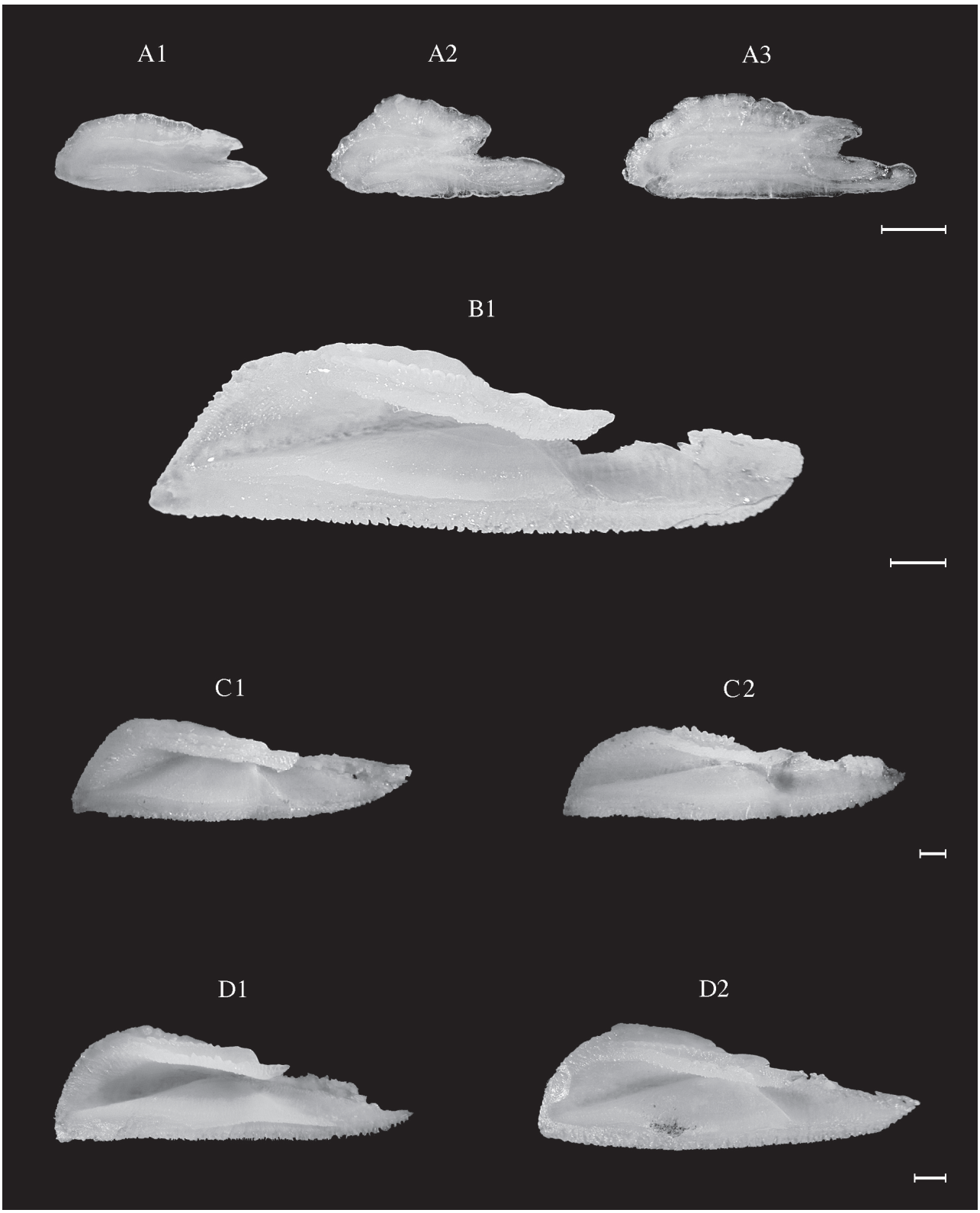

FIG. 85. – *Scomber scrombrus*. FL: A1, 18.1 cm (WM); A2, 32.2 cm (NEA); A3, 36.5 cm (NEA).
Thunnus alalunga (CEA). FL: B1, 123.7 cm.
Thunnus obesus (CEA). FL: C1, 92.0 cm; C2, 93.0 cm.
Thunnus thynnus (WM). FL: D1, no available data.
Scale bar = 1 mm.

Xiphias gladius Linnaeus, 1758 Family XIPHIIDAE

Shape: triangular (triangle-rectangle), dentate margins. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, as long as the cauda. *Cauda*: elliptic, straight, ending far from the posterior margin. *Anterior region*: peaked; rostrum elongated, narrow, pointed; antirostrum broad, long, pointed; excisura wide with a deep, acute notch. *Posterior region*: round to irregular.

OL/TL	OH/OL	Circularity	Rectangularity
-	60.3	26.1	0.3

Schedophilus medusophagus Cocco, 1829 Family CENTROLOPHIDAE

Shape: oval, margins slightly crenate. *Sulcus acusticus*: heterosulcoid, ostial, median, descending. *Ostium*: elliptic, shorter than the cauda, very shallow and poorly defined. *Cauda*: tubular, straight, very narrow, slightly inclined to the ventral area, ending far from the posterior margin. *Anterior region*: round to oblique; rostrum short, broad, round; antirostrum absent; excisura narrow. *Posterior region*: round.

OL/TL	OH/OL	Circularity	Rectangularity
2.5	63.2	14.4	0.2

Schedophilus ovalis (Cuvier, 1833) Family CENTROLOPHIDAE

Shape: oblong, posterior and dorsal margins dentate. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: tubular, curved, slightly flexed posteriorly, ending close to the posterior margin. *Anterior region*: peaked; rostrum moderately short, broad, round; antirostrum short, broad, round; excisura wide with a shallow notch. *Posterior region*: oblique to irregular.

OL/TL	OH/OL	Circularity	Rectangularity
2.6	49.0	18.9	0.3

Schedophilus velaini (Sauvage, 1879) Family CENTROLOPHIDAE

Shape: oblong, dorsal margin irregular and dentate with a deep indentation in the ventral margin that is more prominent in the largest otoliths. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: tubular, curved, slightly flexed posteriorly, ending close to the posterior margin. *Anterior region*: peaked; rostrum moderately short, broad, round; antirostrum poorly defined; excisura wide with a shallow notch. *Posterior region*: oblique to irregular.

OL/TL	OH/OL	Circularity	Rectangularity
2.0-2.2	51.8-55.7	19.1-21.8	0.3

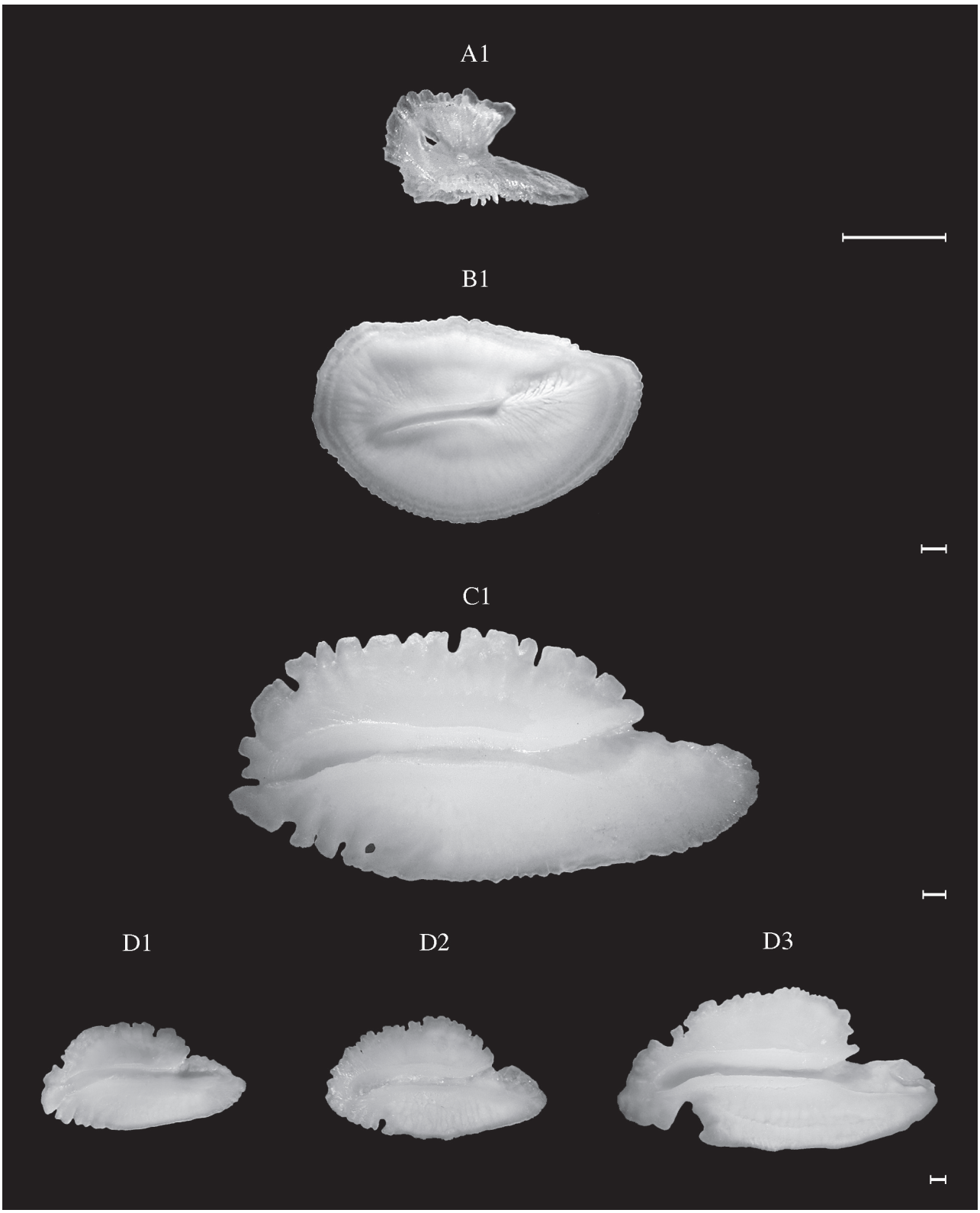

FIG. 86. – *Xiphias gladius* (WM). TL: A1, no available.
Schedophilus medusophagus (WM). TL: B1, 50.0 cm.
Schedophilus ovalis (CEA). TL: C1, 84.3 cm.
Schedophilus velaini (CEA). TL: D1, 58.8 cm; D2, 67.0 cm; D3, 88.6 cm.
Scale bar = 1 mm.

Stromateus fiatola Linnaeus, 1758 Family STROMATEIDAE

Shape: triangular, ventral margin irregular. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: tubular, straight, ending close to the posterior margin. *Anterior region*: peaked; rostrum long, broad, pointed; antirostrum long, narrow, pointed; excisura wide with a deep, acute notch. *Posterior region*: oblique.

OL/TL	OH/OL	Circularity	Rectangularity
2.2	50.3	24.0	0.3

Antigonia capros Lowe, 1843 Family CAPROIDAE

Shape: rhomboidal, ventral area more developed than dorsal, posterior margin sinuate. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: bent, shorter than the cauda. *Cauda*: tubular, straight, slightly ascending, ending close to the posterior margin. *Anterior region*: double-peaked; rostrum short, broad, flattened; antirostrum short, broad, slightly pointed, smaller than the rostrum; excisura narrow with an acute, deep notch. *Posterior region*: angled or round.

OL/TL	OH/OL	Circularity	Rectangularity
5.0-5.6	119.3-149.3	14.5-16.1	(-0.09)-(-0.08)

Capros aper (Linnaeus, 1758) Family CAPROIDAE

Shape: hour-glass, asymmetric with ventral and dorsal areas almost equally developed, ventral margin irregular. *Sulcus acusticus*: heterosulcoid, ostio-caudal, median. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: tubular, straight, bordered by raised crests. *Anterior region*: double-peaked; rostrum and antirostrum large, broad and round or slightly pointed, rostrum longer; excisura wide with an acute, deep notch. *Posterior region*: irregular to double-peaked; postrostrum and postantirostrum short, broad and round, postantirostrum longer; excisura caudalis wide with a shallow to deep, wide notch.

OL/TL	OH/OL	Circularity	Rectangularity
2.2-3.1	100.4-125.7	21.5-28.1	(-0.1)-0.1

Order PLEURONECTIFORMES

Psettodes bennetti Steindachner, 1870 Family PSETTODIDAE

Shape: trapezoidal to fusiform, lobed to irregular ventral margin. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, as long as the cauda or slightly shorter. *Cauda*: tubular, narrow, sinuous, strongly flexed from the middle region, ending far from the posterior margin. *Anterior region*: peaked; rostrum short, broad, pointed; antirostrum absent; excisura wide without a notch. *Posterior region*: peaked. *Circumsulcal depression*: very incomplete, tenuous and limited to slight dorsal and ventral depressions.

OL/TL	OH/OL	Circularity	Rectangularity
3.2	49.1	17.7	0.3

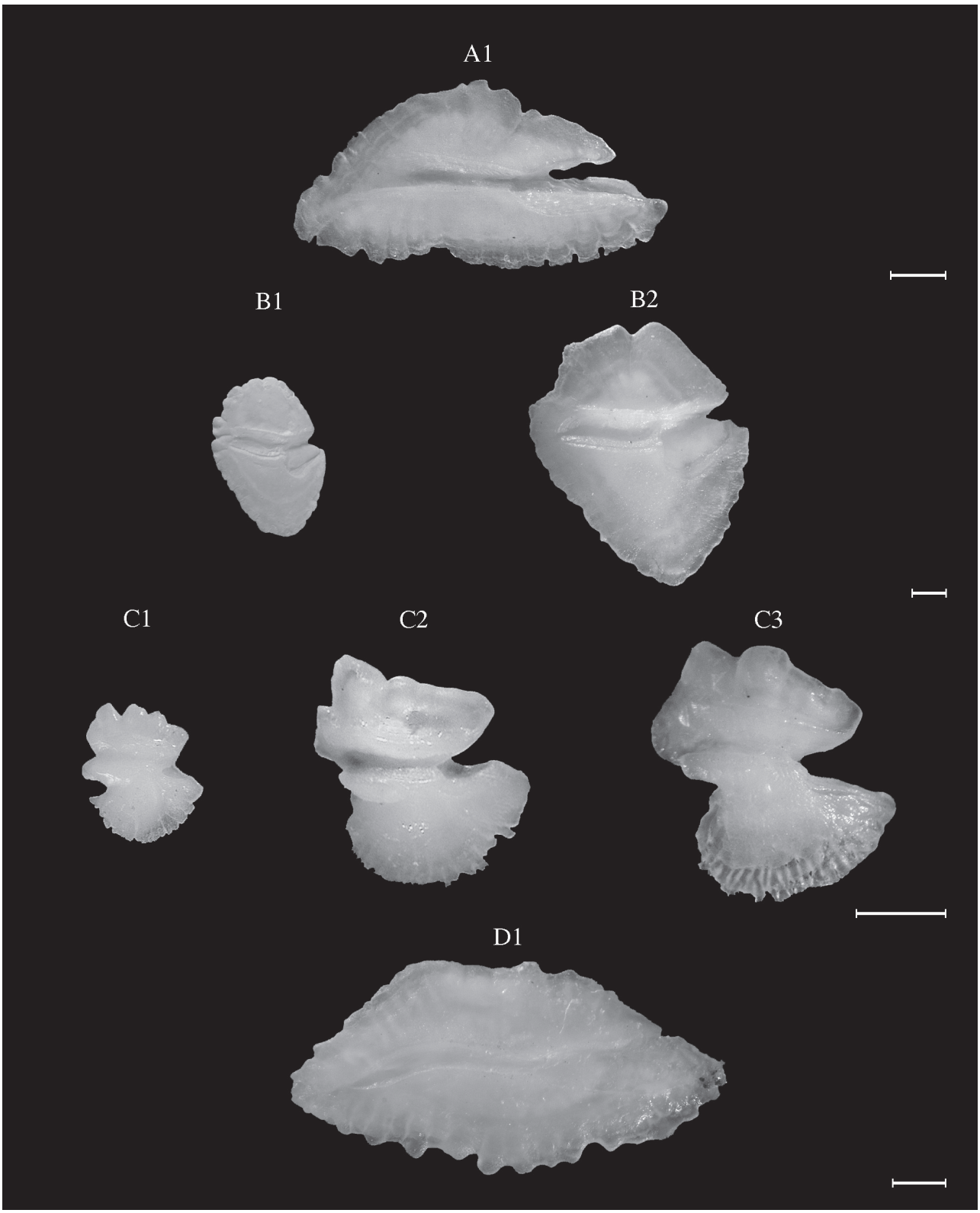

FIG. 87. – *Stromateus fiatola* (NEA). TL: A1, 30.5.
Antigonia capros (CEA). TL: B1, 6.8 cm; B2, 11.0 cm.
Capros aper. TL: C1, 6.0 cm (NEA); C2, 9.5 cm (WM); C3, 11.7 cm (CEA).
Psettodes bennetti (NEA). TL: D1, 25.8 cm.
Scale bar = 1 mm.

Citharus linguatula (Linnaeus, 1758) Family CITHARIDAE

Shape: elliptic to oblong. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like, shorter than the cauda. *Cauda*: tubular, straight, ending close to the posterior margin. *Anterior region*: peaked to double-peaked; rostrum short, pointed, dorsally slightly curved; antirostrum absent or poorly defined; excisura wide with or without a shallow, round notch. *Posterior region*: angled. *Circumsulcal depression*: incomplete, limited to the dorsal and ventral regions.

OL/TL	OH/OL	Circularity	Rectangularity
2.8-3.0	52.9-62.0	14.7-16.4	0.2-0.3

Lepidorhombus boscii (Risso, 1810) Family SCOPHTHALMIDAE

Shape: elliptic to oval. *Sulcus acusticus*: heterosulcoid, ostial, straight, median. *Ostium*: funnel-like, much longer than the cauda. *Cauda*: round-oval, very short, as wide as the ostium, ending far from the posterior margin. *Anterior region*: round to peaked; rostrum short to long, broad, round to pointed; antirostrum absent or poorly defined, short, broad, round or pointed; excisura narrow with or without a shallow or acute notch. *Posterior region*: angled to dorsally round-oblique. *Circumsulcal depression*: incomplete, around the posterior half of the sulcus, close to the sulcus.

OL/TL	OH/OL	Circularity	Rectangularity
2.3-2.5	62.7-76.0	13.5-14.4	0.1-0.2

Lepidorhombus whiffiagonis (Walbaum, 1792) Family SCOPHTHALMIDAE

Shape: elliptic to oval, with dorsal margin sinuate. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: tubular, straight, much longer than the cauda. *Cauda*: round-oval, very short, as wide as the ostium, ending far from the posterior margin. *Anterior region*: angled; rostrum small, broad, round or pointed; antirostrum absent or poorly defined, small, broad, round or pointed; excisura narrow with or without a shallow notch. *Posterior region*: angled to round. *Circumsulcal depression*: incomplete, around the posterior three quarters of the sulcus, narrow and close to the margins.

OL/TL	OH/OL	Circularity	Rectangularity
1.5-2.1	62.7-66.3	14.2-14.6	0.2

Psetta maxima (Linnaeus, 1758) Family SCOPHTHALMIDAE

Shape: cuneiform to bullet-shaped, with margins crenate. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: tubular, straight, much longer than the cauda. *Cauda*: round-oval, short, as wide as the ostium, ending far from the posterior margin. *Anterior region*: angled; rostrum small, broad, round; antirostrum absent or poorly defined, small, broad, round; excisura narrow without a notch. *Posterior region*: flat to oblique, more developed dorsally. *Circumsulcal depression*: incomplete, around the posterior two thirds of the sulcus, wide and approaching the posterior margin.

OL/TL	OH/OL	Circularity	Rectangularity
2.0-2.1	65.6-70.3	14.4-15.4	0.2

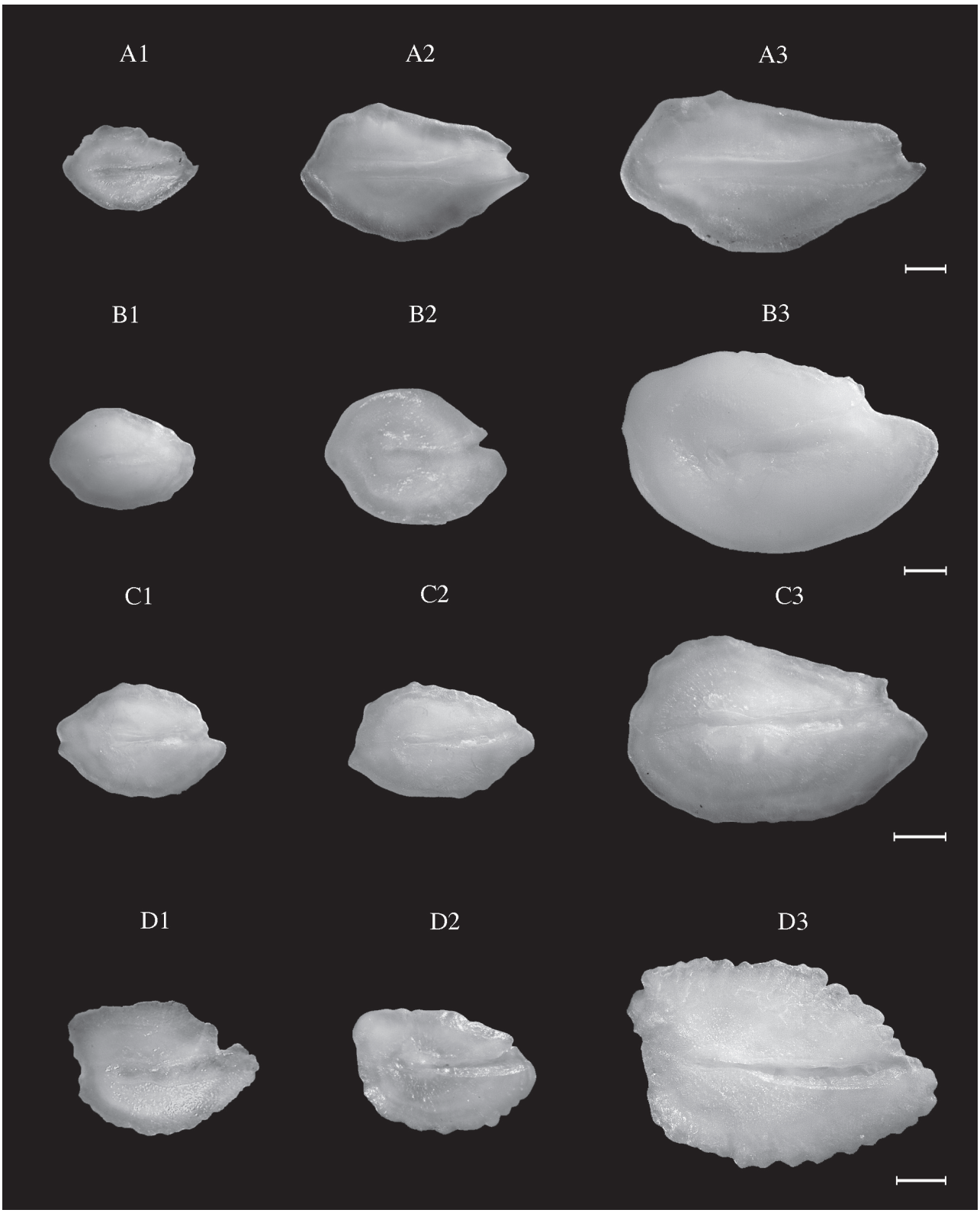

FIG. 88. – *Citharus linguatula*. TL: A1, 11.5 cm (WM); A2, 19.5 cm (NEA); A3, 24.6 cm (NEA).
Lepidorhombus boscii. TL: B1, 15.0 cm (NEA); B2, 17.0 cm (WM); B3, 29.2 cm (NEA).
Lepidorhombus whiffiagonis (NEA). TL: C1, 15.8 cm; C2, 18.9 cm; C3, 37.9 cm.
Psetta maxima. TL: D1, 19.0 cm (WM); D2, 19.2 cm (NEA); D3, 32.6 cm (NEA).
Scale bar = 1 mm.

Scophthalmus rhombus (Linnaeus, 1758) Family SCOPHTHALMIDAE

Shape: elliptic, with dentate to crenate margins, especially the ventral margin. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: tubular, straight, much longer than the cauda. *Cauda*: round-oval, short, as wide as the ostium, ending far from the posterior margin. *Anterior region*: round to angled; rostrum small, borad, round to pointed; antirostrum absent or poorly defined, small, broad, round or pointed; excisura wide with a shallow, angled or round notch. *Posterior region*: lobed, almost double-peaked in larger otoliths. *Circumsulcal depression*: incomplete, around the posterior two thirds of the sulcus, wide and approaching the posterior margin.

OL/TL	OH/OL	Circularity	Rectangularity
1.7-2.0	70.5-81.3	15.4-17.8	0.1-0.2

Platichthys flesus (Linnaeus, 1758) Family PLEURONECTIDAE

Shape: elliptic to oblong, with crenate margins in the smaller otoliths. *Sulcus acusticus*: heterosulcoid, medial, straight, median, ending far from both anterior and posterior margins. *Ostium*: round-oval, as long as the cauda or slightly longer. *Cauda*: round-oval, slightly higher than the ostium. *Anterior region*: angled to blunt. *Posterior region*: round to flattened. *Circumsulcal depression*: incomplete, more conspicuous in the posterior half of the otolith.

OL/TL	OH/OL	Circularity	Rectangularity
1.9-2.3	50.6-62.5	14.5-16.7	0.2-0.3

Arnoglossus imperialis (Rafinesque, 1810) Family BOTHIDAE

Shape: rectangular to elliptic. *Sulcus acusticus*: heterosulcoid, pseudo-ostial, median. *Ostium*: tubular, straight or slightly sinuous, longer than the cauda. *Cauda*: round-oval, as wide as the ostium, ending far from the posterior margin. *Anterior region*: round to angled. *Posterior region*: flat or angled. *Circumsulcal depression*: incomplete, wide, around the posterior two thirds of the sulcus, sometimes very shallow or very inconspicuous around the posterior tip of the cauda.

OL/TL	OH/OL	Circularity	Rectangularity
1.9-2.2	56.8-69.1	13.5-14.5	0.2-0.3

Arnoglossus laterna (Walbaum, 1792) Family BOTHIDAE

Shape: rectangular to bullet-shaped. *Sulcus acusticus*: heterosulcoid, pseudo-ostial, sometimes apparently ostial, median. *Ostium*: tubular, straight, longer and slightly wider than the cauda, frequently with a slight constriction in the middle. *Cauda*: round-oval, higher than the ostium, ending far from the posterior margin. *Anterior region*: round to oblique. *Posterior region*: round to flattened-irregular, slightly concave. *Circumsulcal depression*: incomplete, wide, around the posterior two thirds of the sulcus, sometimes shallow or inconspicuous around the posterior tip of the cauda.

OL/TL	OH/OL	Circularity	Rectangularity
2.1-2.2	66.2-70.0	13.6-14.0	0.2

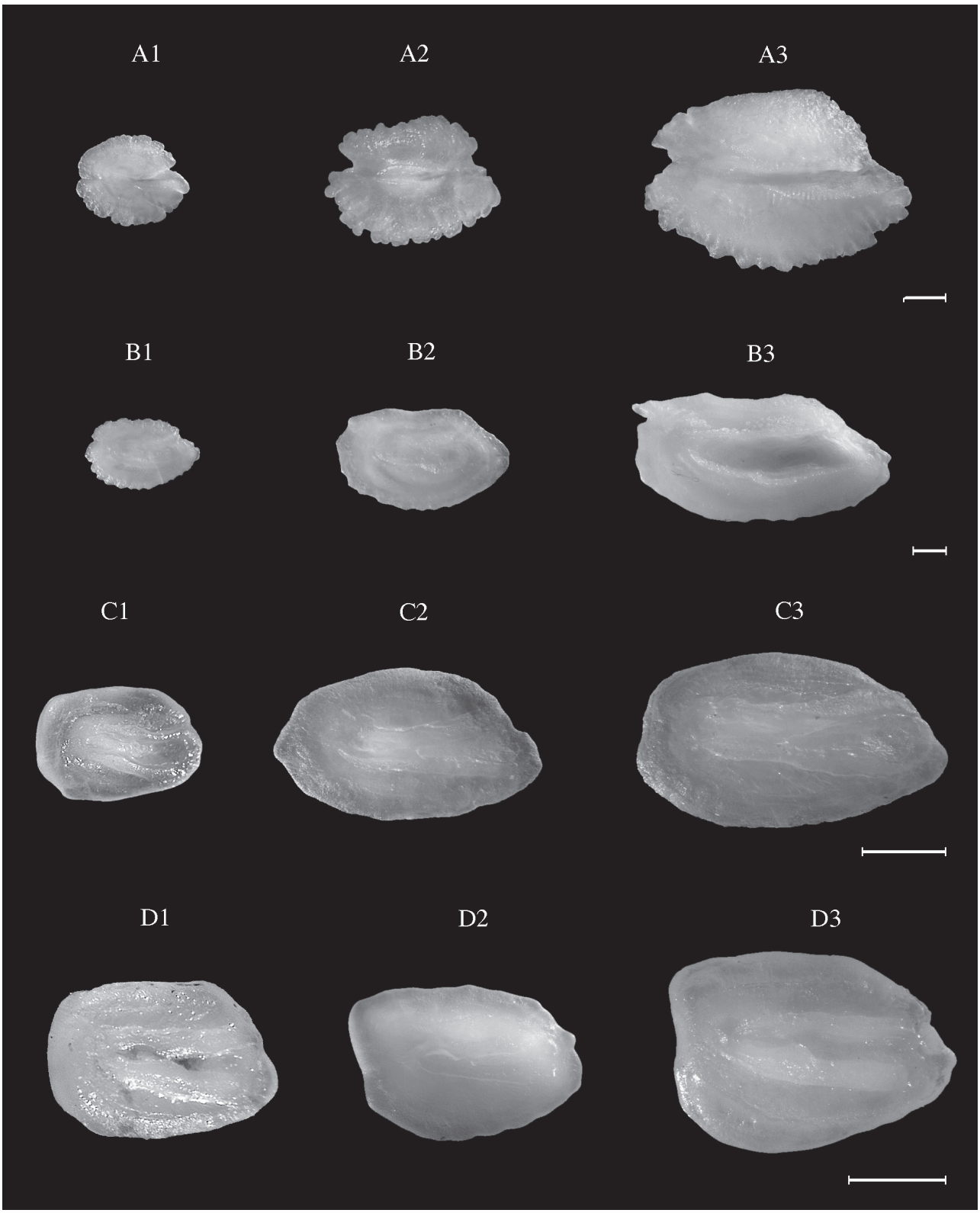

FIG. 89. – *Scophthalmus rhombus.* TL: A1, 14.8 cm (NEA); A2, 20.0 cm (WM); A3, 35.2 cm (NEA).
Platichthys flesus (NEA). TL: B1, 14.5 cm; B2, 26.7 cm; B3, 34.6 cm.
Arnoglossus imperialis. TL: C1, 10.5 cm (WM); C2, 14.3 cm (NEA); C3, 18.8 cm (NEA).
Arnoglossus laterna. TL: D1, 11.0 cm (WM); D2, 11.0 cm (NEA); D3, 14.4 cm (NEA).
Scale bar = 1 mm.

Arnoglossus rueppelii (Cocco, 1844) Family BOTHIDAE

Shape: elliptic. *Sulcus acusticus*: heterosulcoid, pseudo-ostial, sometimes apparently ostial, median. *Ostium*: tubular, straight, longer and slightly wider than the cauda, frequently with a slight constriction in the middle. *Cauda*: round-oval, higher than the ostium, ending far from the posterior margin. *Anterior region*: round. *Posterior region*: round to angled. *Circumsulcal depression*: incomplete, wide, around the entire sulcus, except for the anterior region.

OL/TL	OH/OL	Circularity	Rectangularity
2.0-2.6	67.9-72.8	13.2-13.6	0.2

Arnoglossus thori Kyle, 1913 Family BOTHIDAE

Shape: elliptic. *Sulcus acusticus*: heterosulcoid, ostial, median. *Ostium*: funnel-like to tubular, straight, longer and wider than the cauda, frequently with a slight constriction in the middle. *Cauda*: round-oval, ending far from the posterior margin. *Anterior region*: round to oblique; rostrum small, broad, pointed or round; antirostrum absent or poorly developed, small, broad, round; excisura wide, with or without a shallow notch. *Posterior region*: flat with a slight concavity to oblique. *Circumsulcal depression*: incomplete, wide, around the posterior two thirds of the sulcus, sometimes very shallow or inconspicuous around the posterior tip of the cauda.

OL/TL	OH/OL	Circularity	Rectangularity
2.1-2.2	61.5-68.5	14.2-14.5	0.2

Bothus podas (Delaroche, 1809) Family BOTHIDAE

Shape: elliptic to rectangular. *Sulcus acusticus*: heterosulcoid, ostial, straight, median to slightly inframedian. *Ostium*: funnel-like, longer and wider than the cauda, frequently with a slight constriction in the middle. *Cauda*: round-oval, tapering to the posterior tip, ending far from the posterior margin. *Anterior region*: oblique; rostrum short, broad, round; antirostrum absent or poorly developed, small, broad, round; excisura narrow, with or without a shallow notch. *Posterior region*: irregular to round-flattened. *Circumsulcal depression*: incomplete, wide, around the entire sulcus, except for the anterior region.

OL/TL	OH/OL	Circularity	Rectangularity
1.4-1.9	59.6-66.5	13.8-14.8	0.2-0.3

Bathysolea profundicola (Vaillant, 1888) Family SOLEIDAE

Shape: discoidal. *Sulcus acusticus*: heterosulcoid, medial, median or slightly supramedian. *Ostium*: round-oval, shorter and thinner than the cauda, far from the anterior margin. *Cauda*: round-oval, ending very far from the posterior margin. *Anterior region*: round. *Posterior region*: round. *Circumsulcal depression*: complete, wide around the entire sulcus, except for the anterior region where it becomes thinner, very shallow and less conspicuous.

OL/TL	OH/OL	Circularity	Rectangularity
1.7-2.0	86.2-99.1	12.6-12.9	0.0-0.1

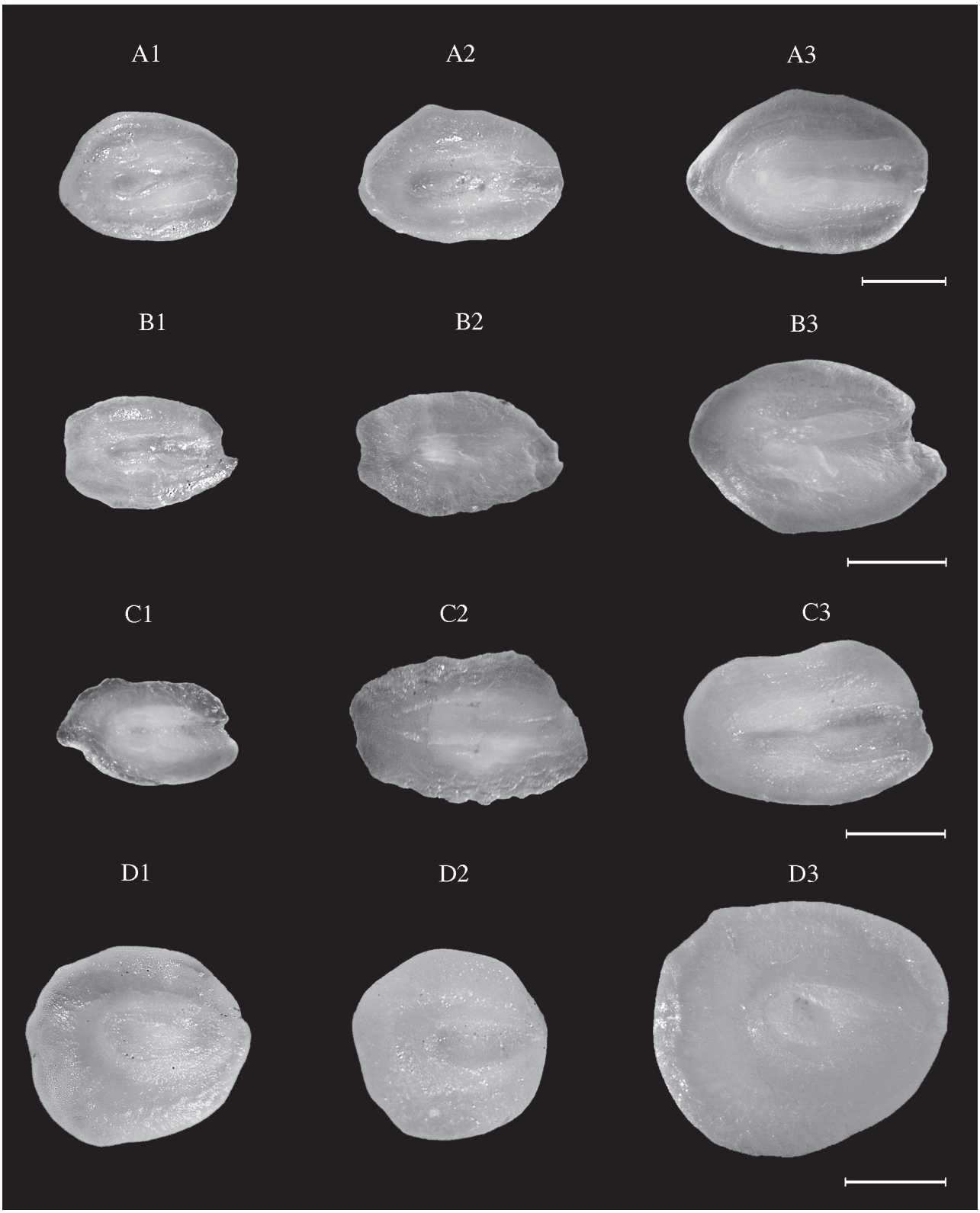

FIG. 90. – *Arnoglossus rueppelii.* TL: A1, 10.0 cm (WM); A2, 10.5 cm (WM); A3, 11.0 cm (NEA).
Arnoglossus thori. TL: B1, 8.0 cm (WM); B2, 9.6 cm (NEA); B3, 12.6 cm (NEA).
Bothus podas. TL: C1, 9.5 cm (NEA); C2, 13.2 cm (CEA); C3, 17.5 cm (WM).
Bathysolea profundicola. TL: D1, 10.0 cm (WM); D2, 11.5 cm (WM); D3, 17.4 cm (NEA).
Scale bar = 1 mm.

Buglossidium luteum (Risso, 1810) Family SOLEIDAE

Shape: discoidal. *Sulcus acusticus*: heterosulcoid, medial, median or slightly supramedian. *Ostium*: round-oval to tubular, close to the anterior margin. *Cauda*: round-oval, very small, shorter than the ostium, ending very far from the posterior margin. *Anterior region*: round. *Posterior region*: round or flattened with a small concavity. *Circumsulcal depression*: complete, wide around the entire sulcus, except for the anterior region where it becomes thinner, very shallow and less conspicuous.

OL/TL	OH/OL	Circularity	Rectangularity
2.2-2.3	79.0-85.4	12.9-13.4	0.1

Dicologlossa cuneata (Moreau, 1881) Family SOLEIDAE

Shape: bullet-shaped. *Sulcus acusticus*: heterosulcoid, medial, median. *Ostium*: tubular, long, with a slight constriction in the middle, close to the anterior margin. *Cauda*: round-oval, as wide as the ostium, but half as long, ending very far from the posterior margin. *Anterior region*: round. *Posterior region*: flattened with more or less conspicuous dentations. *Circumsulcal depression*: incomplete, wide around the entire sulcus, except for the anterior region where there is no depression.

OL/TL	OH/OL	Circularity	Rectangularity
1.7-2.0	68.3-70.7	13.9-14.1	0.2

Dicologlossa hexophthalma (Bennett, 1831) Family SOLEIDAE

Shape: elliptic, dorsal and ventral margin slightly crenate. *Sulcus acusticus*: heterosulcoid, medial, median. *Ostium*: tubular, long, slightly concave dorsally, close to the anterior margin. *Cauda*: round-oval, slightly wider than the ostium and almost as long, ending very far from the posterior margin. *Anterior region*: round. *Posterior region*: round. *Circumsulcal depression*: incomplete, wide around the entire sulcus, except for the anterior region where there is no depression.

OL/TL	OH/OL	Circularity	Rectangularity
2.0-2.3	73.7-80.0	13.3-14.0	0.1-0.2

Microchirus azevia (Brito Capello, 1867) Family SOLEIDAE

Shape: elliptic, dorsal margin sinuate to entire. *Sulcus acusticus*: heterosulcoid, medial, sometimes apparently pseudo-ostial, median. *Ostium*: tubular, long, slightly concave dorsally, very close to the anterior margin. *Cauda*: round-oval, slightly wider than the ostium and almost as long, ending very far from the posterior margin. *Anterior region*: round. *Posterior region*: round. *Circumsulcal depression*: incomplete, wide around the entire sulcus, except for the anterior region where there is no depression.

OL/TL	OH/OL	Circularity	Rectangularity
1.9-2.1	78.0-78.5	13.2-13.3	0.1

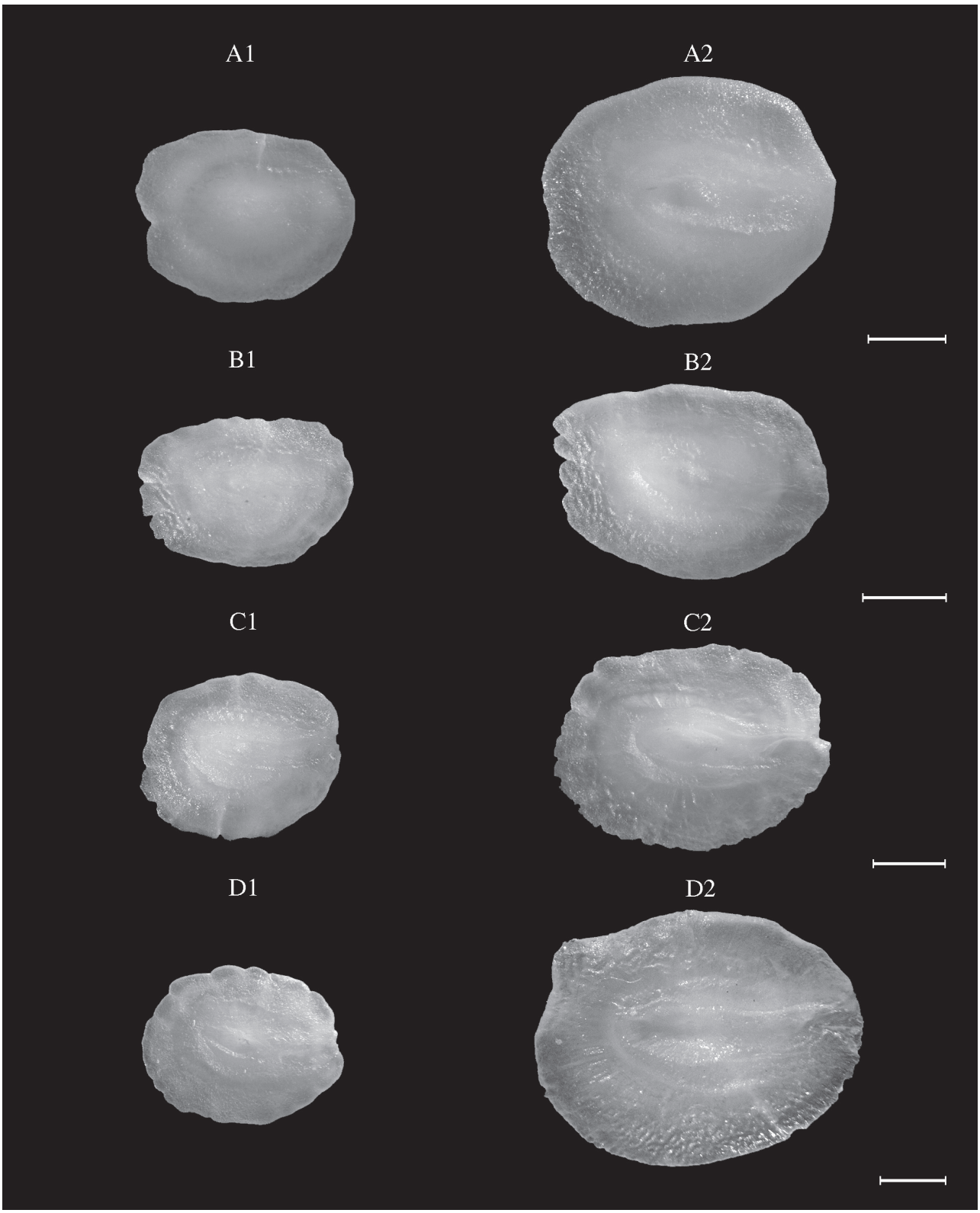

FIG. 91. – *Buglossidium luteum* (NEA). TL: A1, 12.4 cm; A2, 17.2 cm.
Dicologlossa cuneata (NEA). TL: B1, 12.6 cm; B2, 19.2 cm.
Dicologlossa hexophthalma (NEA). TL: C1, 13.1 cm; C2, 19.1 cm.
Microchirus azevia. TL: D1, 14.8 (NEA) cm; D2, 26.7 cm (CEA).
Scale bar = 1 mm.

Microchirus boscanion (Chabanaud, 1926) Family SOLEIDAE

Shape: discoidal to elliptic. *Sulcus acusticus*: heterosulcoid, medial, median. *Ostium*: round-oval, ending far from the anterior margin. *Cauda*: round-oval, as wide and as long as the ostium, far from the posterior margin. *Anterior region*: round to angled. *Posterior region*: round. *Circumsulcal depression*: incomplete, wide around the entire sulcus, except for the anterior region where there is no depression.

OL/TL	OH/OL	Circularity	Rectangularity
2.3-2.5	85.7-86.9	12.8-13.1	0.1

Microchirus ocellatus (Linnaeus, 1758) Family SOLEIDAE

Shape: elliptic. *Sulcus acusticus*: heterosulcoid, medial, median. *Ostium*: round-oval, far from the anterior margin. *Cauda*: round-oval, as wide and as long as the ostium, ending far from the posterior margin. *Anterior region*: round to angled. *Posterior region*: round. *Circumsulcal depression*: complete, wide and well marked around the entire sulcus, except for the anterior region where it becomes thinner, shallower and less conspicuous.

OL/TL	OH/OL	Circularity	Rectangularity
2.2-2.6	76.4-79.6	13.0-13.1	0.1

Microchirus variegatus (Donovan, 1808) Family SOLEIDAE

Shape: elliptic, square or bullet-shaped. *Sulcus acusticus*: heterosulcoid, medial, median. *Ostium*: tubular, long, slightly concave dorsally, sometimes with a slight constriction in the middle, close to the anterior margin. *Cauda*: round-oval, slightly wider and shorter than the ostium, ending far from the posterior margin. *Anterior region*: round. *Posterior region*: round to more or less flattened with a slight concavity. *Circumsulcal depression*: incomplete, wide around the entire sulcus, except for the anterior region where there is no depression.

OL/TL	OH/OL	Circularity	Rectangularity
2.1-2.5	83.7-89.4	13.0-13.2	0.1

Monochirus hispidus Rafinesque, 1814 Family SOLEIDAE

Shape: discoidal to elliptic. *Sulcus acusticus*: heterosulcoid, medial, median. *Ostium*: round-oval, long, far from the anterior margin. *Cauda*: round-oval, as wide as the ostium and slightly shorter, ending very far from the posterior margin. *Anterior region*: round to angled. *Posterior region*: round. *Circumsulcal depression*: incomplete, wide around the entire sulcus, except for the anterior region where there is no depression.

OL/TL	OH/OL	Circularity	Rectangularity
2.1-2.2	75.4-83.9	13.0-13.2	0.1

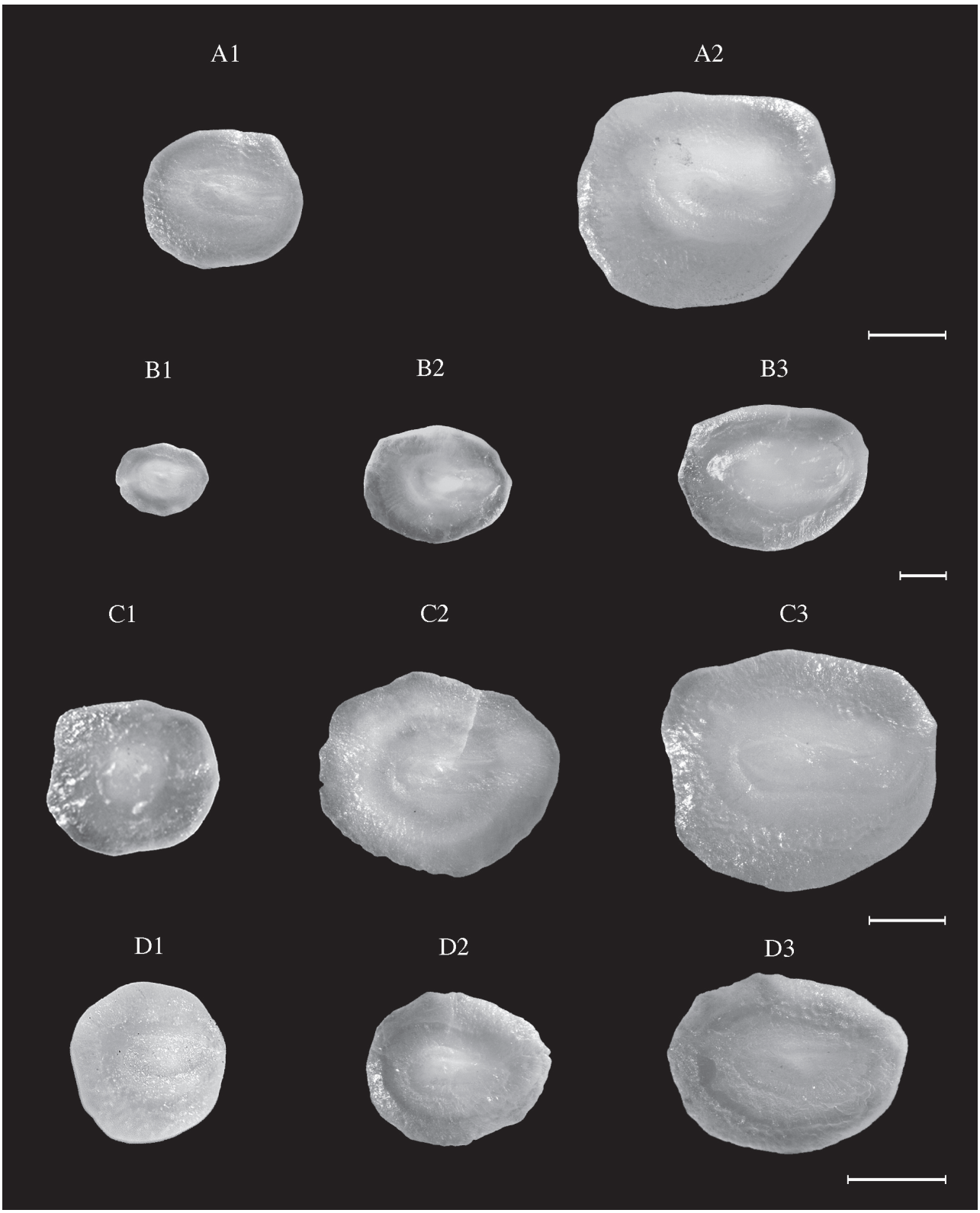

FIG. 92. – *Microchirus boscanion* (NEA). TL: A1, 9.0 cm; A2, 13.2 cm.
Microchirus ocellatus. TL: B1, 7.5 cm (NEA); B2, 14.5 cm (WM); B3, 15.5 cm (WM).
Microchirus variegatus. TL: C1, 9.0 cm (WM); C2, 12.3 cm (NEA); C3, 17.2 cm (NEA).
Monochirus hispidus. TL: D1, 5.5 cm (WM); D2, 8.3 cm (NEA); D3, 11.3 cm (NEA).
Scale bar = 1 mm.

Pegusa cadenati Chabanaud, 1954 Family SOLEIDAE

Shape: bullet-shaped. *Sulcus acusticus*: heterosulcoid, medial, median. *Ostium*: tubular, long, with a slight constriction in the middle, very close to the anterior margin. *Cauda*: round-oval, slightly wider and shorter than the ostium, ending very far from the posterior margin. *Anterior region*: angled. *Posterior region*: flattened, slightly concave. *Circumsulcal depression*: poorly defined and incomplete, wide around the entire sulcus, except for the anterior region where there is no depression.

OL/TL	OH/OL	Circularity	Rectangularity
1.7	68.2	14.4	0.2

Pegusa lascaris (Risso, 1827) Family SOLEIDAE

Shape: elliptic to bullet-shaped. *Sulcus acusticus*: heterosulcoid, medial, sometimes may appear pseudo-ostial, median. *Ostium*: tubular, long, slightly concave dorsally, occasionally with a slight constriction in the middle, very close to the anterior margin. *Cauda*: round-oval, as wide as the ostium but shorter, ending far from the posterior margin. *Anterior region*: round to dorsally oblique. *Posterior region*: flattened, slightly concave. *Circumsulcal depression*: incomplete, wide around the entire sulcus, except for the anterior region where there is no depression.

OL/TL	OH/OL	Circularity	Rectangularity
1.3-1.7	74.9-78.3	13.5-13.9	0.1

Solea senegalensis Kaup, 1858 Family SOLEIDAE

Shape: bullet-shaped, sinuate margins. *Sulcus acusticus*: heterosulcoid, medial, it may appear pseudo-ostial, median. *Ostium*: tubular, long, concave dorsally, occasionally with a slight constriction in the middle, ending very close to the anterior margin. *Cauda*: round-oval, as wide as the ostium but shorter, ending far from the posterior margin. *Anterior region*: round. *Posterior region*: flattened, slightly to deeply concave and dorsally oblique. *Circumsulcal depression*: incomplete, wide and deep around the entire sulcus, except for the anterior region where there is no depression.

OL/TL	OH/OL	Circularity	Rectangularity
1.4-1.6	75.6-78.7	13.3-14.6	0.1

Solea solea (Linnaeus, 1758) Family SOLEIDAE

Shape: elliptic to bullet-shaped. *Sulcus acusticus*: heterosulcoid, medial, sometimes apparently pseudo-ostial, median. *Ostium*: tubular, long, concave dorsally, occasionally with a slight constriction in the middle, wider than the cauda, ending close to the anterior margin. *Cauda*: round-oval, as wide as the ostium but shorter, ending far from the posterior margin. *Anterior region*: round. *Posterior region*: flattened. *Circumsulcal depression*: incomplete, wide and deep around the entire sulcus, except for the anterior region where there is no depression.

OL/TL	OH/OL	Circularity	Rectangularity
1.3-1.8	75.1-91.7	13.1-13.5	0.0-0.1

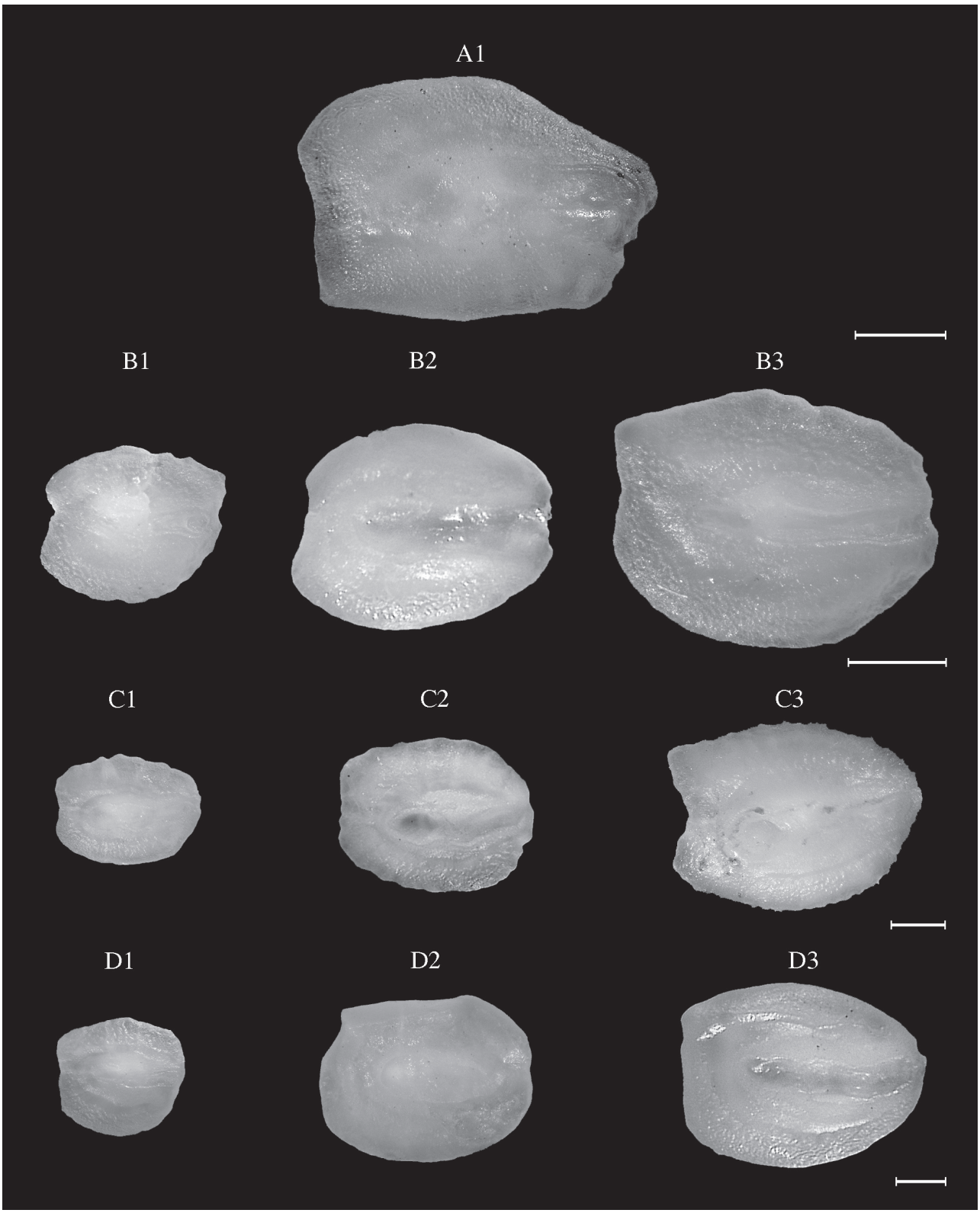

FIG. 93. – *Pegusa cadenati* (CEA). TL: A1, 23.8 cm.
Pegusa lascaris. TL: B1, 11.6 cm (NEA); B2, 19.0 cm (WM); B3, 25.6 cm (NEA).
Solea senegalensis. TL: C1, 16.2 cm (NEA); C2, 26.0 cm (WM); C3, 32.7 cm (CEA).
Solea solea. TL: D1, 16.2 cm (NEA); D2, 23.1 cm (CEA); D3, 36.5 cm (WM).
Scale bar = 1 mm.

Synaptura lusitanica Brito Capello, 1868 Family SOLEIDAE

Shape: bullet-shaped, with a conspicuous posterior dorsal prominence, dorsal margin sinuate. *Sulcus acusticus*: heterosulcoid, medial, sometimes apparently pseudo-ostial, median. *Ostium*: tubular, very long, wider than the cauda, slightly concave dorsally, with a conspicuous constriction in the middle, very close to the anterior margin. *Cauda*: round-oval, much shorter than the ostium, ending far from the posterior margin. *Anterior region*: angled. *Posterior region*: oblique, flat or slightly to deeply concave. *Circumsulcal depression*: incomplete, close to the margins, wide and deep around the entire sulcus, except for the anterior region where there is no depression.

OL/TL	OH/OL	Circularity	Rectangularity
1.1-1.4	52.8-59.4	15.0-16.8	0.3

Synapturichthys kleinii (Risso, 1827) Family SOLEIDAE

Shape: bullet-shaped. *Sulcus acusticus*: heterosulcoid, medial, sometimes apparently pseudo-ostial, median. *Ostium*: tubular, long, occasionally with a slight constriction in the middle, very close to the anterior margin. *Cauda*: round-oval, as wide as the ostium, but half as long, ending far from the posterior margin. *Anterior region*: round to angled. *Posterior region*: flattened, sometimes slightly concave. *Circumsulcal depression*: incomplete, wide and deep around the entire sulcus, except for the anterior region where there is no depression.

OL/TL	OH/OL	Circularity	Rectangularity
1.2-1.5	73.9-76.3	13.6-13.7	0.1-0.2

Cynoglossus browni Chabanaud, 1949 Family CYNOGLOSSIDAE

Shape: bullet-shaped, with antero-dosal margin irregular. *Sulcus acusticus*: heterosulcoid, medial to pseudo-ostial, straight, inframedian. *Ostium*: tubular, shorter and much narrower than the cauda, very close to the anterior ventral margin. *Cauda*: round to discoidal, ending far from the posterior margin, higher than the ostium. *Anterior region*: round. *Posterior region*: flattened, slightly concave. *Circumsulcal depression*: almost complete, narrow, especially in the posterior region.

OL/TL	OH/OL	Circularity	Rectangularity
1.6	77.2	14.2	0.1

Cynoglossus canariensis Steindachner, 1882 Family CYNOGLOSSIDAE

Shape: oval, more globular posteriorly, to irregular. *Sulcus acusticus*: heterosulcoid, medial to pseudo-ostial, straight, median. *Ostium*: round-oval, slightly shorter and much narrower than the cauda, very close to the anterior ventral margin. *Cauda*: round-oval, wide, flattened posteriorly, ending far from the posterior margin. *Anterior region*: round. *Posterior region*: oblique to irregular. *Circumsulcal depression*: almost complete, less evident in the anterior ventral region.

OL/TL	OH/OL	Circularity	Rectangularity
1.7	72.1	14.2	0.2

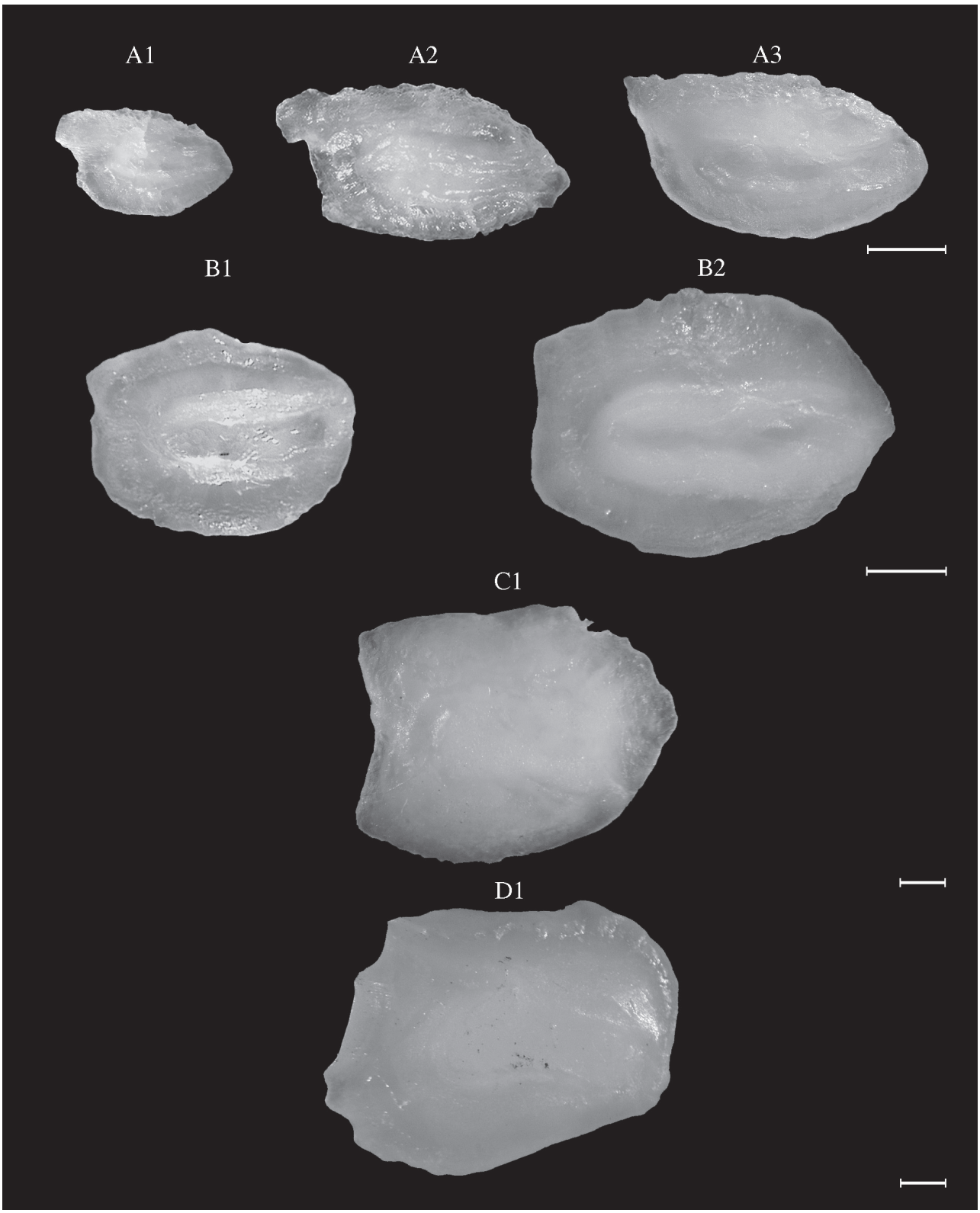

FIG. 94. – *Synaptura lusitanica.* TL: A1, 16.2 cm (NEA); A2, 31.0 cm (WM); A3, 35.0 cm (NEA).
Synapturichthys kleinii. TL: B1, 23.0 cm (WM); B2, 38.0 cm (CEA).
Cynoglossus browni (CEA). TL: C1, 43.5 cm.
Cynoglossus canariensis (CEA). TL: D1, 48.5 cm.
Scale bar = 1 mm.

Cynoglossus senegalensis (Kaup, 1858) Family CYNOGLOSSIDAE

Shape: bullet-shaped, with antero-dorsal margin sinuate. *Sulcus acusticus*: heterosulcoid, medial to pseudo-ostial, straight, median. *Ostium*: round-oval, shorter and much narrower than the cauda, close to the anterior margin. *Cauda*: round-oval, wide, flattened posteriorly, ending far from the posterior margin. *Anterior region*: round. *Posterior region*: flattened, slightly concave. *Circumsulcal depression*: almost complete, although not very conspicuous.

OL/TL	OH/OL	Circularity	Rectangularity
1.5	75.7	14.3	0.1

Symphurus ligulatus (Cocco, 1844) Family CYNOGLOSSIDAE

Shape: discoidal. *Sulcus acusticus*: heterosulcoid, medial, straight, median. *Ostium*: round-oval, very small, shorter and much narrower than the cauda, close to the anterior margin. *Cauda*: round to discoidal, ending far from the posterior margin. *Anterior region*: round. *Posterior region*: round. *Circumsulcal depression*: complete, narrow, parallel and very close to the border of the otolith.

OL/TL	OH/OL	Circularity	Rectangularity
3.4-3.5	80.3-80.9	12.9-13.1	0.1

Symphurus nigrescens Rafinesque, 1810 Family CYNOGLOSSIDAE

Shape: discoidal, with dorsal margin round to angled. *Sulcus acusticus*: heterosulcoid, medial, straight, median. *Ostium*: round-oval, very small, shorter and much narrower than the cauda, far from the anterior margin. *Cauda*: round-oval, flattened posteriorly, ending far from the posterior margin. *Anterior region*: round. *Posterior region*: round. *Circumsulcal depression*: complete, narrow, parallel and very close to the border of the otolith, especially in the posterior region.

OL/TL	OH/OL	Circularity	Rectangularity
1.8-2.0	84.0-93.7	12.7-13.0	0.0-0.1

Order TETRAODONTIFORMES

Balistes capriscus Gmelin, 1789 Family BALISTIDAE

Shape: irregular, asymmetric, ventral area more developed, fan shaped and very fragile. *Sulcus acusticus*: heterosulcoid, ostial, supramedian, with a crista ventral well developed and very high, protruding in the excisura. *Ostium*: funnel-like, as long as the cauda. *Cauda*: elliptic, curved, slightly flexed, ending close to the posterior margin. *Anterior region*: notched, thin and very fragile plate; rostrum long, broad, angled; antirostrum short, broad, round, globose; excisura very wide with a deep, acute notch hidden by the crista ventral. *Posterior region*: angled, thicker with a deep, narrow, angular postero-dorsal indentation.

OL/TL	OH/OL	Circularity	Rectangularity
1.0-1.2	77.4-78.7	18.8-19.0	0.1

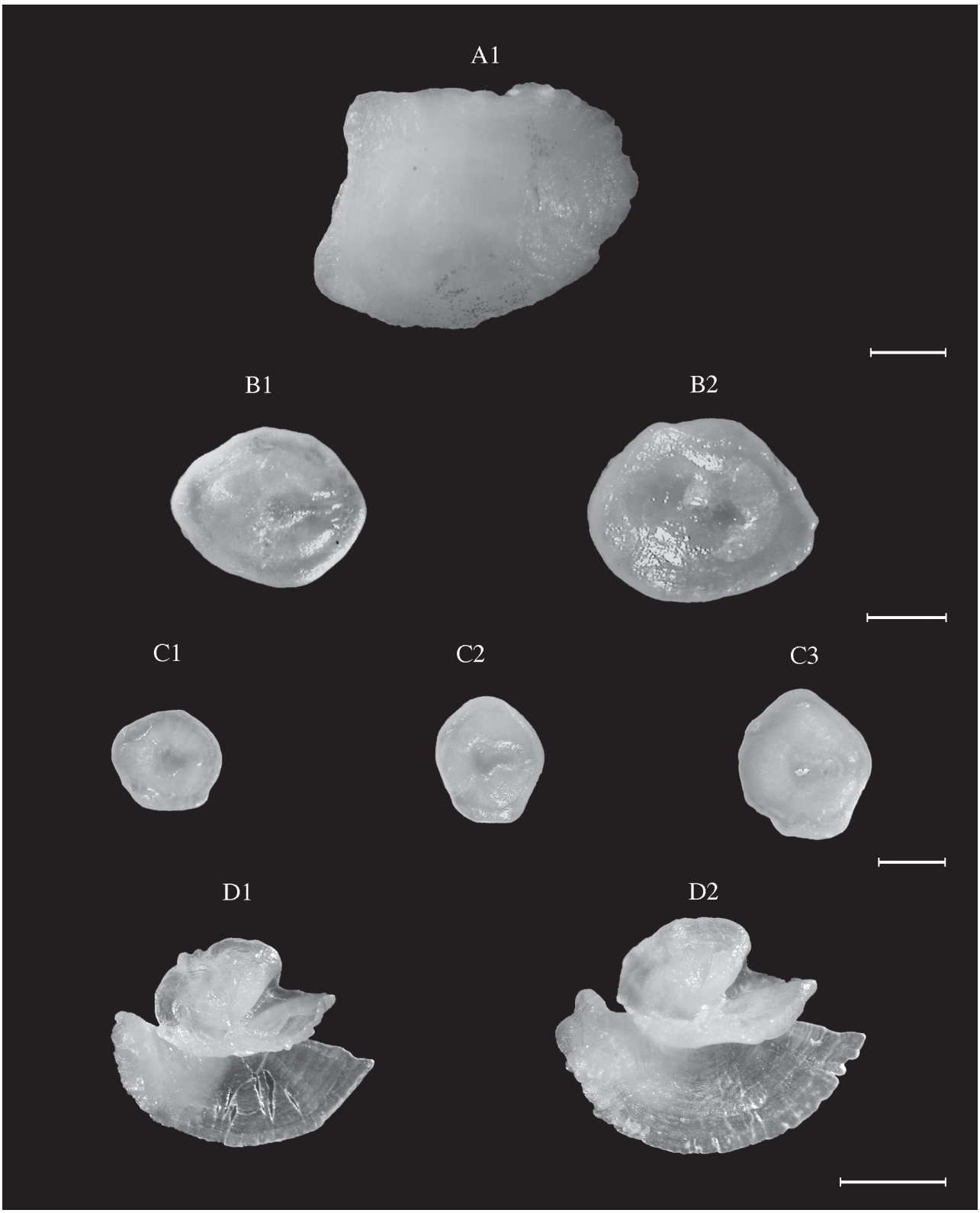

FIG. 95. – *Cynoglossus senegalensis* (CEA). TL: A1, 30.0 cm.
Symphurus ligulatus (WM). TL: B1, 7.0 cm; B2, 8.5 cm.
Symphurus nigrescens (WM). TL: C1, 8.5 cm; C2, 10.5 cm; C3, 11.5 cm.
Balistes capriscus (NEA). TL: D1, 27.5 cm; D2, 20.4 cm.
Scale bar = 1 mm.

Stephanolepis hispidus (Linnaeus, 1766) Family MONACANTHIDAE

Shape: hour-glass, asymmetric. *Sulcus acusticus*: homosulcoid, ostio-caudal, median, with a crista ventral well developed, high, round, protruding in both excisurae. *Ostium*: funnel-like, as long as the cauda. *Cauda*: straight. *Anterior region*: notched; rostrum and antirostrum very short, very broad, flattened to irregular or flattened; excisura very wide with a shallow notch hidden by the crista ventral. *Posterior region*: notched; pseudo-rostrum long, broad, flattened to irregular; pseudo-antirostrum long, broad, pointed; excisura very wide with a deep notch hidden by the crystal ventral.

OL/TL	OH/OL	Circularity	Rectangularity
1.1	98.9	25.5	0.0

Canthigaster capistrata (Lowe, 1839) Family TETRAODONTIDAE

Shape: hour-glass, asymmetric, ventral area more developed with triangular-shape. *Sulcus acusticus*: homosulcoid, ostio-caudal, supramedian, concave, with a voluminous ventral crista. *Ostium*: elliptic, as long as the cauda. *Cauda*: straight. *Anterior region*: notched; rostrum long, broad, round; antirostrum short, very broad, angular; excisura very wide with a deep, acute notch. *Posterior region*: notched, pseudo-rostrum long, broad, angled; pseudo-antirostrum short, broad, round; excisura caudalis wide with a shallow round notch.

OL/TL	OH/OL	Circularity	Rectangularity
1.1	78.4	22.1	0.1

Lagocephalus lagocephalus (Linnaeus, 1758) Family TETRAODONTIDAE

Shape: hour-glass, asymmetric, ventral area more developed, fan shaped. *Sulcus acusticus*: homosulcoid, ostio-caudal, median. *Ostium*: funnel-like, as long as the cauda. *Cauda*: straight. *Anterior region*: notched; rostrum long, broad, angled; antirostrum absent; excisura very wide without a notch. *Posterior region*: notched, pseudo-rostrum long, broad, angled; pseudo-antirostrum absent; excisura caudalis wide without a notch.

OL/TL	OH/OL	Circularity	Rectangularity
0.3	93.9	19.1	0.0

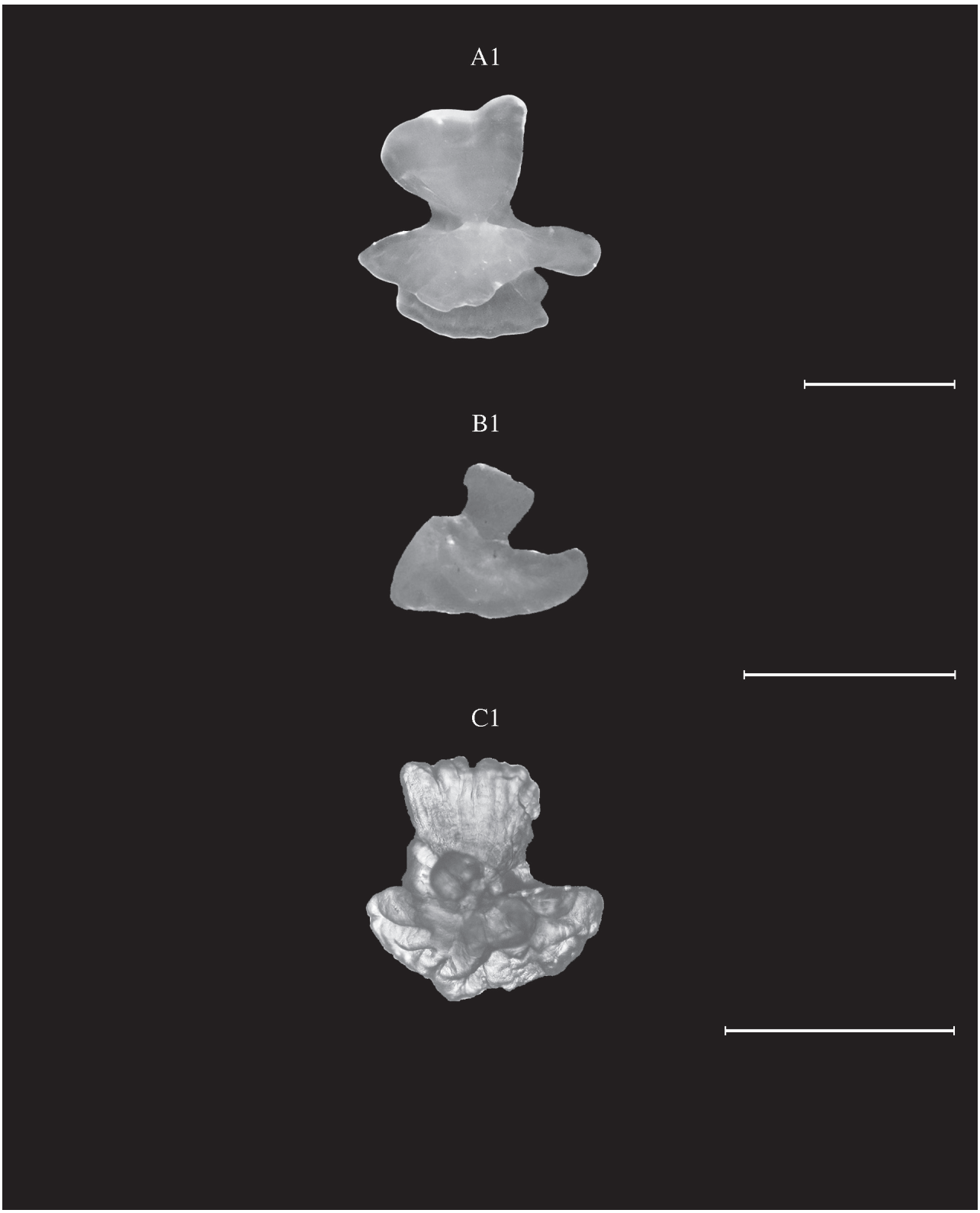

FIG. 96. – *Stephanolepis hispidus* (CEA). TL: A1, 13.5 cm.
Canthigaster capistrata (CEA). TL: B1, 8.3 cm.
Lagocephalus lagocephalus (CEA). TL: C1, 37.2 cm.
Scale bar = 1 mm.

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